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July 15, 1980

Energy Research Abstracts

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UNITED STATES DEPARTMENT OF ENERGY

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ENERGY RESEARCH ABSTRACTS

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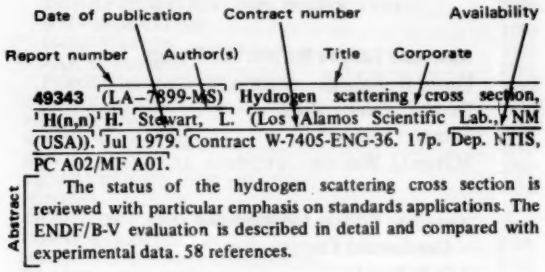
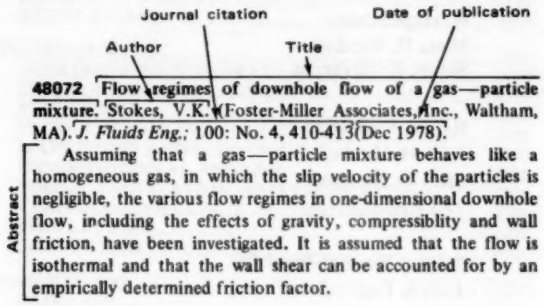

Date of publication
Contract number
Availability
Report number
Author(s)
Title
Corporate
49343 (LA–7899-MS) Hydrogen scattering cross section, ¹H(n,n)¹H. Stewart, L. (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 17p. Dep. NTIS, PC A02/MF A01.
Abstract
The status of the hydrogen scattering cross section is reviewed with particular emphasis on standards applications. The ENDF/B-V evaluation is described in detail and compared with experimental data. 58 references.


Journal citation
Date of publication
Author
Title
48072 Flow regimes of downhole flow of a gas—particle mixture. Stokes, V.K. (Foster-Miller Associates, Inc., Waltham, MA). J. Fluids Eng.; 100: No. 4, 410-413 (Dec 1978).
Abstract
Assuming that a gas—particle mixture behaves like a homogeneous gas, in which the slip velocity of the particles is negligible, the various flow regimes in one-dimensional downhole flow, including the effects of gravity, compressiblity and wall friction, have been investigated. It is assumed that the flow is isothermal and that the wall shear can be accounted for by an empirically determined friction factor.

•INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA)*. These indexes are cumulated semiannually and annually. Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

•Corporate Index

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

49343 (LA–7899-MS) Hydrogen scattering cross section, ¹H(n,n)¹H. Stewart, L. **(Los Alamos Scientific Lab., NM (USA))**. Jul 1979. Contract W-7405-ENG-36. 17p. Dep. NTIS, PC A02/MF A01.

is indexed as:

Los Alamos Scientific Lab., NM (USA)
Advanced laser fusion target fabrication research and development proposal, 4:48249 (LA–7619-P)
Hydrogen scattering cross section, ¹H(n,n)¹H, 4:49343 (LA–7899-MS)

•Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Stewart, L., Hydrogen scattering cross section, ¹H(n,n)¹H, 4:49343 (LA–7899-MS)
Stewart, M.D., *See* McInroy, J.F., 4:49280
Stewart, W., *See* Dean, J.W., 4:48543
Stimson, J., Reproduction, growth, and survival of Enewetak corals, 4:49200 (NVO–0703-1, pp 56-59)

•Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

HYDROGEN 1 TARGET/NEUTRON REACTIONS
Hydrogen scattering cross section, ¹H(n,n)¹H (Above 100 keV, review), 4:49343 (LA–7899-MS)
HYDROGEN NITRATES
See NITRIC ACID
HYDROLOGY/RESEARCH PROGRAMS
Inventory of advanced energy technologies and energy conservation research and development: 1976-1978. Volume II. Prepared for the Committee on Science and Technology, U.S. House of Representatives, Ninety-Sixth Congress, 4:48749

•Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

W-7405-ENG-36	**Los Alamos Scientific Lab., NM (USA)**	
	3:49698	LA-tr–78-45
	3:49857	LA–7224T
	3:49863	LA–7235-MS
W-7405-ENG-48	**California Univ., Livermore (USA). Lawrence Livermore Lab.**	
	3:49386	UCRL–52456
	3:49431	UCRL–52405

•Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. While not reports, patents and conference papers are indexed here as a matter of convenience.

LA-7899-MS	4:49343	Dep. NTIS, PC A02/MF A01
LA-tr-78-69	4:48158	Dep. NTIS, PC A03/MF A01

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ENERGY RESEARCH ABSTRACTS

COAL AND COAL PRODUCTS

19893 (DOE/BETC/QPR—79/3) **Liquid fossil fuel technology. Quarterly technical progress report, July-September 1979.** Linville, B. (ed.). (Department of Energy, Bartlesville, OK (USA). Bartlesville Energy Technology Center). Feb 1980. 57p. Dep. NTIS, PC A04/MF A01.

The in-house results at Bartlesville Energy Technology Center on the liquid fossil fuel cycle are presented. The cycle covers extraction, processing, utilization, and environmental technology of the liquid fuels derived from petroleum, heavy oils, tar sands, oil shale, and coal.

PROCESSING

REFER ALSO TO CITATION(S) 19899, 19989, 20931

DESULFURIZATION AND PURIFICATION

REFER ALSO TO CITATION(S) 19902, 19905, 19943, 19944, 19945, 19950, 19962, 20534

19894 **Gas cleaning apparatus.** US Patent Application 039,427. [nd]. 12p.

A gas cleaning apparatus located in a high temperature (up to 1000°F) high pressure (20 or more atmospheres) gas flow path between a coal gasifier and a gas turbine, for removal of entrained dust having particle diameters in the range of 1 to 10 microns from the gas stream, includes an outer housing which encloses an inner rotatable, cylindrical centrifuge having a graduated series of vanes formed on the outside of the centrifuge. The vanes on the exterior surface of the centrifuge smoothly accelerate the process gas to a high tangential velocity to separate the particulate impurities from the gas, while not triggering secondary mixing of the particulate impurities. The gas enters a cyclone at maximum axial velocity and ultra-high tangential velocity where the particulate matter separates and is ejected from the bottom of the cyclone. The centrifuge encloses an integral, interior, axial turbine through which the cleaned high pressure process gas from the core of the cyclone vortex flows to drive the turbine and the centrifuge.

19895 (FE—3297-1) **Development of unique catalysts for hydrodenitrogenation of coal-derived liquids. First quarterly report, September 15-December 15, 1978.** Katzer, J.R.; Stiles, A.B.; Kwart, H. (Delaware Univ., Newark (USA). Dept. of Chemical Engineering). 1 Mar 1979. Contract EI-78-S-01-3297. 122p. Dep. NTIS, PC A06/MF A01.

Four experimental runs were made; two used decahydroquinoline as reactant and two runs were made using orthoethylaniline and quinoline-N-oxide respectively. The decahydroquinoline runs indicate that the carbon-nitrogen bond scission is not thermal but clearly catalytic. Important findings resulted from the run using o-ethylaniline and future runs will help define reaction pathways. Quinoline-N-oxide was rapidly deoxygenated to form quinoline under the conditions tested. Future runs will be conducted in the absence of hydrogen to avoid deoxidation of quinoline-N-oxide and to find out whether carbon-nitrogen bond scission can be promoted by the addition of oxygen to the quinoline molecule. A review paper has been prepared that reviews the existing chemistry and technology for hydrodenitrogenation and projects catalyst and process needs for hydrodenitrogenation of synthetic feedstocks and heavy petroleum liquids. It projects what should be a more effective means and more rational basis for the design and development of more active and more selective catalysts for hydrodenitrogenation and attempts some speculations on potentially fruitful direction to be followed in both catalyst and process development.

19896 (FE—3297-2) **Development of unique catalysts for hydrodenitrogenation of coal-derived liquids. Second quarterly report, December 15, 1978-March 15, 1979.** Katzer, J.R.; Stiles, A.B.; Kwart, H. (Delaware Univ., Newark (USA). Dept. of Chemical Engineering). 15 May 1979. Contract EI-78-S-01-3297. 31p. Dep. NTIS, PC A03/MF A01.

Experimental runs using decahydroquinoline, o-ethylaniline, and aniline as reactants have been made. Results from decahydroquinoline runs show that carbon-nitrogen bond scission occurs by a catalytic route; it is not thermal. Strong Bronsted acid sites do not crack carbon-nitroge bonds; carbon-nitrogen bond scisson must therefore occur on other sites on the catalyst. Anilines are an important species in hydrodenitrogenation of multi-ring aromatic systems. Hydrodenitrogenation of anilines clearly shows kinetic behavior characteristic of hydrogenation including positive order dependence on hydrogen pressure and an activation energy between that for hydrogenation and that for cracking; yet the primary product appears to be the fully aromatic ring. To better understand the mechanism of hydrodenitrogenation of anilines and of substituted anilines, hydrodenitrogenation of aniline and o-ethylaniline was studied over a presulfided Ni-Mo/Al_2O_3 catalyst, and a reaction network has been determined for aniline hydrodenitrogenation. Aniline hydrodenitrogenaton appears to involve partial hydrogenation of the benzene ring to reduce aromatic resonance with the nitrogen atom reducing the C-N bond strength and facilitating elimination of NH_3.

19897 (FE—3297-3) **Development of unique catalysts for hydrodenitrogenation of coal-derived liquids. Third quarterly report, March 15-June 15, 1979.** Katzer, J.R.; Stiles, A.B.; Kwart, H. (Delaware Univ., Newark (USA). Dept. of Chemical Engineering). 1 Aug 1979. Contract EI-78-S-01-3297. 57p. Dep. NTIS, PC A04/MF A01.

Experimental runs using decahydroquinoline and quinoline as reactants have been made. Results from decahydroquinoline runs show that the strong Bronsted acid catalyst such as HY-zeolite, intermediate Bronsted acid catalyst such as silica-alumina and weak Bronsted acid catalyst such as γ-alumina does not catalyze carbon-nitrogen bond scission. The carbon-nitrogen bond scission must therefore occur on other sites on the catalyst. In all likelihood, the olefinic products formed with these nonhydrogenating catalysts are polymerized on the surfaces of these acidic catalysts thereby making them inactive. There was no significant difference in nitrogen removal rate between the sulfided and unsulfided HY-zeolite catalyst, which indicated that sulfiding does not deactivate the HY-zeolite catalyst. The nature of cataytic function responsible for carbon-nitrogen bond scission has been studied using decahydroquinoline over a set of catalysts. The catalysts tested include catalysts with Co, Ni, Mo impregnated on silica-alumina or γ-alumina. The results showed that the rate of nitrogen removal was highest for Mo on γ-alumina catalyst. Several catalysts with the objective to develop uniquely new hydrogenation catalysts that will selectively coordinate the nitrogen atom and remove it without hydrogenating the entire ring thereby reducing hydrogen consumption, were prepared. The catalysts chosen for this study were aluminum borate and aluminum borate phosphate, impregnated with 4 wt % Nickel. Preliminary results showed that 4 wt % Ni on aluminum borate catalyst gives a marked increase in nitrogen removal in quinoline.

19898 (MTI—79TR16) **Centrifugal separation of particulate matter. Phase II. Cold-flow test of the cyclocentrifuge. Final report.** Albrecht, P.; McCabe, J.T. (Mechanical Technology, Inc., Latham, NY (USA)). 14 Dec 1979. Contract EX-76-C-01-2428. 92p. Dep. NTIS, PC A05/MF A01.

Although there are other areas where high efficiency separation of fine particulate matter can make a beneficial contribution toward accelerating the commercial viability of some coal conver-

sion processes, the cleanup of low Btu fuel gas for a gas turbine application was designated as the immediate target for this program. The work described herein follows a feasibility study in which the role of gas centrifuge technology in coal conversion processes was examined. This study concluded that particulate separation was an area in which some of the concepts from centrifuge technology could be applied to improve the performance of existing equipment. As part of the study, a design approach following centrifuge concepts was established and, to show feasibility, preliminary design calculation and drawings were made for a separation device based on a combined-cycle electric power application. The selected application required stringent particulate removal from 125,000 scfm of coal-produced low Btu gas at 1000°F and 250 psia. In this study, the projected separation efficiency was estimated to be about 85% for an ash particle of 1 micron, which was a significant improvement over existing cyclones. The separation device was named a cyclocentrifuge because it consisted of a cyclone containing a centrifuge. Basically, the concept was founded upon certain critical assumptions which are given.

19899 (ORO—5076-1) **Hot gas desulfurization. Interim report.** Schrodt, J.T. (Kentucky Univ., Lexington (USA). Research Foundation). Nov 1976. Contract EY-76-S-05-5076. 11p. Dep. NTIS, PC A02/MF A01.

Good progress has been made in meeting the initial objectives of the Hot Gas Desulfurization project. All equipment has been received or fabricated, and the fixed bed desulfurization apparatus 95 percent assembled. The apparatus has been tested to 300 psig and 1500°F. A new Varian GC and CDC-111 for automated gas analysis has been inserted into the system and fully calibrated for all gases. Four US gasifier coal ashes, to be used for the H_2S and COS sorbents, have been received and are being physically and chemically characterized. Iron oxide content of these range from 3 to 23 percent, surface areas from 0.5 to 15.0 m^2/g and pore volumes from 0.01 to 0.1 cc/g. Reaction equilibrium computations have been completed and indicate the basic process has a high potential for desulfurizing the fuel gases through reduction of the H_2S and COS to less than 12 ppM at 1100°F. A dynamic fixed bed model of the process has been developed and computer coded; full verification of this awaits procurement of more data. Desulfurization experiments in the revamped apparatus are slated for November. A 1000 Mw power staion fuel supply has been selected as the basis for the design phase. A flowsheet for the commercial process has been prepared and material and energy balances have been partially completed.

19900 (ORO—5076-2) **Hot gas desulfurization. Progress report.** Schrodt, J.T. (Kentucky Univ., Lexington (USA). Research Foundation). Feb 1977. Contract EY-76-S-05-5076. 15p. Dep. NTIS, PC A02/MF A01.

Desulfurization experiments in the revamped system have been initiated. Twelve tests with Western Kentucky No. 9 gasifier coal ash were made in the last month in 35 mm i.d. quartz reactor tubes at low pressures, temperatures in the range 800 to 1300°F, and with space velocities in the range 1000 to 1600 hr^{-1}. Contrary to expectations, the capacity of an ash sample to sorb H_2S and COS, in the early stages of use, increases with each regeneration. After twelve oxidations, 70 percent of the iron inherently contained in the ash is directly utilizable. Reduction of hematite (Fe_2O_3) occurs in the early period of gas desulfurization, consuming CO and H_2. Carbonyl sulfide (COS) is formed from reaction of CO and H_2S. The chemistry of the total process can for the most part be explained from thermodynamic equilibrium calculations and solid component phase diagrams. In the course of desulfurization the reduction product FeO reacts with H_2S and COS forming solid FeS. There is no experimental evidence for the formation of new gaseous constituents that are not already in the gasifier product gases. The water gas shift reaction occurs during processing and in the absence of appreciable water vapor there is a tendency for carbon deposition.

HYDROGENATION

19901 (LBL—9777) **Kinetics and mechanism of metal-carbonyl-catalyzed hydrogenation of aromatic hydrocarbon models for coal constituents.** Derencsenyi, T.T.; Vermeulen, T. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1979. Contract W-7405-ENG-48. 231p. Dep. NTIS, PC A11/MF A01.

Thesis.

Transition-metal carbonyls have been investigated as potential co-catalysts for use in non-pyrolytic coal liquefaction process employing massive amounts of molten zinc chloride as both an acidic cracking catalyst and vehicle for the products. Upon substitution with alkyl phosphine and other ligands, transition-metal carbonyls become more stable than the parent compound and are viable homogeneous catalyst for hydrogenating aromatic model compounds of coal such as anthracene and quinoline. Homogeneous catalytic hydrogenation of anthracene by $Mn_2(CO)_8(PBu_3)_2$ and cyclohexene by $RhCl(PPh_3)_3$ were studied, and mechanisms for both reactions are presented. The manganese operates by two competing steps, the formation of a trihydride and an anthracene-manganese complex reacting to produce 9,10-dihydroanthracene, whereas the rhodium forms a dihydride-olefine-rhodium complex whose decomposition is the rate determining step. Substitution of the phosphine ligands on $Mn_2(CO)_8(PBu_3)_2$ show that the rate of anthracene hydrogenation is dependent on the nature of the ligand. The rate did not correlate with the basicity of the phosphine, but additivity effects were noted which led to an excellent correlation of the rate with ^{31}P NMR shift of the phosphine oxide. This correlation has been shown to be a novel linear free-energy relationship that may be extended to other metal complexes for the purposes of describing catalytic activity and the mechanistic details of reactions, such as oxidative addition of hydrogen, cis-trans equilibrium, and ligand exchange.

GASIFICATION

REFER ALSO TO CITATION(S) 19894, 19900, 19980, 19984, 19985, 19986, 19990, 20031, 20248, 20354, 20577

19902 (BNL—51117) **Alternative process schemes for coal conversion. Progress report No. 3, June 1-August 31, 1979.** Sansone, M.J.; Dang, V.D. (Brookhaven National Lab., Upton, NY (USA)). Oct 1979. Contract EY-76-C-02-0016. 24p. Dep. NTIS, PC A02/MF A01.

In coal gasification processes such as the flash hydropyrolysis or the Exxon catalytic process, methane is the major desired end product. However, methane is usually produced along with hydrogen and/or carbon monoxide. To obtain pipeline grade methane, it is necessary to develop economical methods of separating methane from hydrogen and/or carbon monoxide mixtures. The hydrogen and carbon monoxide are then recycled in the process. Several separation technologies such as absorption/stripping, cryogenic, clathrate formation have been examined. In this report, an absorption/stripping process calculation using propane as the absorption solvent for separation of methane from hydrogen and carbon monoxide has been performed. Detailed material and energy balances for the process as well as the dimensions of the absorber and the stripper are reported. Other major pieces of equipment such as heat exchangers pumps, and compressors were evaluated in order to determine the equivalent electrical energy of the process as approximately 13550 cal(e)/gm-mole methane produced. The purity of methane in the final stream is 96% by volume at 100°F and 1000 psi. The present process appears to be a potential working process for methane separation in large quantity.

19903 (CONF-790749—) **Advanced materials for alternative fuel capable directly fired heat engines.** Fairbanks, J.W.; Stringer, J. (eds.). (Department of Energy, Washington, DC (USA). Assistant Secretary for Fossil Energy; Electric Power Research Inst., Palo Alto, CA (USA). Fossil Fuel and Advanced Systems Div.). Dec 1979. 976p. Dep. NTIS, PC A99/MF A01.

From Conference on advanced materials for alternate fuel capable directly fired heat engines; Castine, ME, USA (30 Jul 1979).

The first conference on advanced materials for alternative fuel capable directly fired heat engines was held at the Maine Maritime Academy, Castine, Maine. It was sponsored by the US Department of Energy, (Assistant Secretary for Fossil Energy) and the Electric Power Research Institute, (Division of Fossil Fuel and Advanced Systems). Forty-four papers from the proceedings have been entered into EDB and ERA and one also into EAPA; three had been entered previously from other sources. The papers are concerned with US DOE research programs in this area, coal gasification, coal liquefaction, gas turbines, fluidized-bed combustion and the materials used in these processes or equipments. The materials papers involve alloys, ceramics, coatings, cladding, etc., and the fabrication and materials listing of such materials and studies involving corrosion, erosion, deposition, etc. (LTN)

19904 (CONF-790749—, pp 18-27) **Advanced Fossil Power Systems department clean fuel program.** Alpert, S.B.; Rovesti, W. (Electric Power Research Inst., Palo Alto, CA). Dec 1979.

From Conference on advanced materials for alternate fuel capable directly fired heat engines; Castine, ME, USA (30 Jul 1979).

The objective of the EPRI program is to produce fuels from a variety of US coals that are useful for a mix of power generating systems, that are economically competitive and that satisfy projected environmental standards. In conjunction with the R & D program comprehensive engineering and economic evaluations are carried out to assess the relative attractiveness new processes for application by the power industry for new and retrofit applications. The EPRI studies indicate that: (1) Integrated gasification combined cycle plan using off the shelf combustion turbines are economically competitive with pulverized fuel plants that use flue gas desulfurization, and (2) with more stringent air, water, and solid waste standards IGCC plants appear even more attractive. The Clean Liquid and Solid Fuel programs support R & D in direct and indirect techniques to bring a number of technologies to a status of technical readiness that will permit commercial plants to be reliably designed by the mid to late

1980's. The programs involve a wide variety of fuels meeting utility specifications and will be able to utilize a large variety of US coals. Major projects being supported are listed. An associated R & D program has as its objectives: (1) More reliable combustion turbine equipment for generating electricity, and (2) adapting combustion turbine equipment to utilize synthetic fuels.

19905 (CONF-790749—, pp 113-127) **Coal gasification status.** Holt, N.A.; O'Shea, T.P. (Electric Power Research Inst., Palo Alto, CA). Dec 1979.

From Conference on advanced materials for alternate fuel capable directly fired heat engines; Castine, ME, USA (30 Jul 1979).

Several factors are contributing to a strongly revived interest in coal gasification technology. Many gasification processes are available or are being developed to suit a wide variety of possible applications. One obvious application is, of course, electric power generation and EPRI studies have indicated that integrated gasification-combined cycle (IGCC) plants have the potential for becoming a major electrical energy producer in the future. The preferred technology for such an application is considered by EPRI to be the pressurized, single-stage, extrained method of gasification, the most advanced example of which is the Texaco process. EPRI-funded test runs currently under way at Texaco's pilot plant are expected to confirm the ability of the process to meet the transient response requirements of a utility power system and provide valuable information on the quality of the product gas and other effluents. Moreover, the planned demonstration of the technology in an IGCC configuration at the 1000 tons per day scale by Southern California Edison (SCE) and Texaco at SCE's existing Cool Water generating station, with anticipated support from EPRI and others, is expected to yield the necessary information for such systems to be applied commercially by the end of the 1980's.

19906 (COO—2904-15) **Chemical and physical stability of refractories for use in coal gasification. Fifteenth quarterly progress report, November 1, 1979-January 31, 1980.** Fakhr, A.; Day, D.E. (Missouri Univ., Rolla (USA)). 31 Jan 1980. Contract EY-76-S-02-2904. 29p. Dep. NTIS, PC A03/MF A01.

The dependence of the chemical reactions occurring in the cement bond portion of the castables upon the degree of saturation has now been determined for pure steam (500 and 1000 psia, 10 days), and the DOE atmosphere (1000 psia, 10 days). Boehmite, $C_4A_5H_9$ and calcite are the major components formed in the above mentioned atmospheres. Of these, only the amount of boehmite varied significantly with the degree of saturation of the atmosphere. A linear relationship exists between the percent saturation and the amount of boehmite up to ~ 70% saturation. Above ~ 70% saturation the amount of boehmite is nearly constant and independent of the degree of saturation. The minimum percent saturation required to form boehmite varied from ~ 10% to ~ 30% according to the atmosphere and pressure. The mechanical properties (namely flexural strength) also varied with the percent saturation along with the formation of new compounds. Those parts of the specimens exposed to >50% saturated atmosphere were appreciably stronger (2 to 3 times) than those parts in contact with an atmosphere whose saturation was <50%. The relative severity of the corrosion of several refractory castables by either liquid or saturated vapor has been determined for pure steam (500 and 1000 psia, 10 days), the DOE atmosphere (1000 psia and 10, 44, and 60 days) and CO-steam atmospheres of CO/steam ratio = 0.1, 1.0, and 3.0 (1000 psia, 20 days). The major results of these experiments have been described in the previous reports. This report summarizes the thermal expansion data obtained for the castables after exposure to above mentioned atmospheres and conditions.

19907 (COO—5066-T1) **Fuel Gas Demonstration Plant Program: Small-Scale Industrial Project. Environmental impact analysis preliminary evaluation. Technical progress report No. 2.** (McKee (Arthur G.) and Co., Cleveland, OH (USA)). 28 Feb 1978. Contract ET-78-C-01-2578;EW-78-C-02-5066. 109p. Dep. NTIS, PC A06/MF A01.

19908 (COO—5066-T2) **Fuel Gas Demonstration Plant Program: Small-Scale Industrial Project. Plan for obtaining coal, April 28, 1978. Technical progress report No. 4.** (McKee (Arthur G.) and Co., Cleveland, OH (USA)). 1978. Contract ET-78-C-01-2578;EW-78-C-02-5066. 49p. Dep. NTIS, PC A03/MF A01.

The demonstration plant shall have a nominal coal throughput of 500 tons/day and be designed to be expanded to provide the requirements for the conceptual commercial plant in the most economical fashion. Gasification technology is to be selected in Phase I. STOIC, Wellman Incandescent, and Woodall-Duckham, two stage fixed-bed air blown gasification technologies shall be evaluated during Phase I selection process. Stretford sulfur removal/recovery technology shall be employed. The demonstration plant is to be located within the perimeter of Erie Mining Company's plant site in Hoyt Lakes, Minnesota. The plant design shall utilize the best economical technology available to minimize energy consumption for utilities and plant services.

19909 (COO—5066-T3) **Fuel Gas Demonstration Plant Program: Small-Scale Industrial Project. Coal handling trade-off study preliminary evaluation, August 30, 1978. Technical progress report No. 5.** (McKee (Arthur G.) and Co., Cleveland, OH (USA)). 1978. Contract ET-78-C-01-2578;EW-78-C-02-5066. 479p. Dep. NTIS, PC A09/MF A01.

To investigate all feasible methods of handling coal, source information was gathered by visits with local dock facilities, meeting with a commercial railroad and talking with materials handling contractors. Eastern coal can be received by vessel at three different ports and shipped to Hoyt Lakes via rail. Primary screening, if desired, can be done at any of the receiving locations. The fines from dockside primary screens can be used by Erie Mining Company's Taconite Harbor power plant, or, if necessary, sold to other users. Western coal can be delivered directly to the plantsite by unit trains. Alternate uses of Eastern or Western coal fines from screening at the gasification plantsite include agglomerating use in the Taconite Harbor power plant, or sale to others. Considering all of the influencing variables in different combinations, a total of 102 alternatives were defined. In addition, 21 different plans for receiving gasifier coal at the Taconite harbor facility were evaluated to determine the most economical possibility from an operational as well as a capital investment standpoint. This selection method was used in the overall study. To evaluate the many alternatives, a computer program was developed to calculate the capital and operating cost for each alternative. The computer program contained 39 capital cost items, and the capital cost for each alternative was a total of the items necessary to make the alternative operational. Similarly, there were 58 operating cost items, and the operating cost for each alternative was a total of the items which applied. The computer program provided prompt, updated reports as the capital and operating cost estimates for the items were refined, and will allow future reiterations as new costs are adjusted during design and estimating activities as the project proceeds.

19910 (COO—5066-T4) **Fuel Gas Demonstration Plant Program: Small-Scale Industrial Project. Pot grate-low Btu gas firing. Technical progress report No. 6.** (McKee (Arthur G.) and Co., Cleveland, OH (USA)). 9 Oct 1978. Contract ET-78-C-01-2578;EW-78-C-02-5066. 11p. Dep. NTIS, PC A02/MF A01.

Updraft pot grate pelletizing tests were performed to determine the effect that low oxygen content in the flue gas from burning low Btu fuel from a coal gasification plant, has on clustering and pellet quality. Of prime importance was the effect of the exothermic reaction when the pellets made the transition from the low oxygen upper stove air to the high oxygen shaft air. The lowest shaft furnace upper stove oxygen level evaluated was 6%. When the pellets were subjected to 20% oxygen lower stove shaft air, an average bed temperature increase of 39°F was measured. With upper stove oxygen levels of 9 and 12%, the temperature increase was 29 and 13°F, respectively. Pellet quality was over 96% + 1/4 in. A. T. in all tests and compression strength exceeded 500 lbs. Clustering of the pellet burden was not a problem. It is concluded that the use of low Btu gas that may produce zones in the upper stove with as low as 6% oxgyen, will not have an adverse effect on pellet quality.

19911 (COO—5066-T5) **Fuel Gas Demonstration Plant Program: Small-Scale Industrial Project. Coal gasification stirrer material study. Technical report No. 7.** (McKee (Arthur G.) and Co., Cleveland, OH (USA)). 18 Jan 1979. Contract ET-78-C-01-2578;EW-78-C-02-5066. 99p. Dep. NTIS, PC A05/MF A01.

Basic Technology Incorporated was retained by Babcock Contractors to determine material feasibility for a stirrer used in a coal gasification unit now being designed. Materials are readily available if water cooling of the stirrer is permitted. The purpose of this report is to identify materials which could be used in a non water-cooled operation. The stirrer configuration is shown: Shaft A will have a maximum design temperature of 1000°F; Shaft B will have a maximum design temperature of 1200°F. In establishing feasibility, the items considered are: cost of material; availability of material; hydrogen embrittlement; and general material design compatability. Scoping calculations, based on elementary elasticity and plasticity, are used with high temperature properties to determine pipe sizes. Several materials were evaluated in this investigation with the final considerations given to Stainless Steel Grades 304, 316L and to Inconel 800 H. A comparison of the yield strengths of these three materials is given. Stainless Steel, Grade 316L, has the higher yield strength. Based on this, the calculations contained herein and experience, Stainless Steel Grade 316L is recommended. The material surface can be treated by a process, Alonizing, to reduce erosion, as well as produce a hard surface which would increase fatigue life.

19912 (COO—5066-T6) **Fuel Gas Demonstration Plant Program: Small-Scale Industrial Project. Preliminary briquetting review. Technical report No. 8.** (McKee (Arthur G.) and Co., Cleveland, OH (USA)). 23 Jan 1979. Contract ET-78-C-01-2578;EW-78-C-02-5066. 158p. Dep. NTIS, PC A08/MF A01.

The Erie/DOE Contract EW-78-C-02-5066 scope of work defines a design basis for the Demonstration and Commercial Plants

using a western coal as well as an eastern coal for the design. During the period of initial plant design, it became apparent that many uncertainties were prevalent in the use of western coals in gasifier operation. One such uncertainty was the generation of coal fines in western coal handling and their subsequent use in gasifiers of fixed bed design. Eventually it became apparent that western coal was technically a ri: : for the Woodall Duckham gasifier design selected for the Erie gasification process. As a result, Erie investigated the possible use of western coal fines agglomerated for use in the gasification process and proposed that a study be conducted to provide the feasibility of agglomerating western coals and their subsequent use in the Woodall Duckham gasifier. Technical Report Number 8 contains the initial background material gathered by Erie for use in determining if an agglomeration study should be conducted and also for rough costing coal agglomeration for inclusion in the economic study of the Coal Handling Report issued by Erie and the Economic Evaluation for the Demonstration and Commercial Plants (western coal cases). Erie Mining Company reiterates the need for a coal fines agglomeration study in order to determine the feasibility of using western coal as the design basis for either a Demonstration or Commercial Plant. Erie Mining Company received direction from the DOE not to proceed in outlining a study program for agglomerating coals but Erie further recommends such a study be completed before or concurrent with Phase II detail design of the Demonstration Plant.

19913 (COO—5066-T7) **Fuel Gas Demonstration Plant Program: Small-Scale Industrial Project. Coal procurement activities. Technica report No. 9.** (McKee (Arthur G.) and Co., Cleveland, OH (USA)). 14 Apr 1979. Contract ET-78-C-01-2578;EW-78-C-02-5066. 70p. Dep. NTIS, PC A04/MF A01.

This report consists of reference material taken from Erie Mining Company project files and includes the following: (1) Investigation of the Main Coal Producing Fields in the United States: This report identifies potential coal fiels for gasifier feedstock and factors influencing coal selection. The report analyzes coal fields located in five separate regions of the United States. Three design coals are discussed and lab reports have been included. Also included are cost considerations for selected coals and preliminary cost data and transportation routing. (2) Analysis of Test Coals Received at Erie Mining Company: Rosebud, Clarion, and Clarion-Brookfield-Kittaning coal samples were received and analyzed at Erie Mining Company. The screen analysis indicated the severe decrepitation of the Rosebud western coal. (3) Criteria for Gasifier Coal: In this study, BCI states that gasifier feed should have the following characteristics: (1) the ratio between the upper and lower size for coal should be 3:1; (2) coal fines should not exceed 10%; (3) coal grading limits which can be handled are maximum range 3" x 1", minimum range - 1 1/2" x 1/2".

19914 (COO—5066-T8) **Fuel Gas Demonstration Plant Program: Small-Scale Industrial Project. Specification manual.** (McKee (Arthur G.) and Co., Cleveland, OH (USA)). 5 Jan 1979. Contract ET-78-C-01-2578;EW-78-C-02-5066. 1220p. Dep. NTIS, PC A99/MF A01.

The Project Specification Manual has been prepared to define the minimum standards of quality acceptable to McKee, Erie Mining Company and the US Department of Energy.

19915 (COO—5066-T9) **Fuel Gas Demonstration Plant Program: Small-Scale Industrial Project. Environmental assessment statement.** (Ecological Consultants, Inc., Fort Collins, CO (USA)). Feb 1979. Contract ET-78-C-01-2578;EW-78-C-02-5066. 285p. Dep. NTIS, PC A13/MF A01.

Solid, liquid, and gaseous by-products and wastes are generated during coal storage and processing, gasification, and gas cleanup. Recovery systems have been designed to collect and utilize by-products. Wastes will be placed in storage areas designed to prevent release of the materials to the environment. The coal gasification plant along with the solid waste disposal area will occupy approximately 115 acres. To prevent, to the fullest extent possible, degradation of groundwater and surface water resources, the coal stockpile, landfill, collection pond, settling basin, and drainage ditches will be constructed to prevent the seepage of potential contaminants into groundwater or the drainage of runoff into surface waters. Cooling water is the primary water requirement of the project. None of the water utilized in the gasification plant will be released into the area surface water system, but will be either recycled or directed into the settling basin. The gasification facility has the potential of emitting a broad spectrum of pollutants into the atmosphere. However, effective emission control procedures such as off-gas recycling, hydrogen sulfide removal, particulate removal, and flaring will be applied to minimize the plant's emissions. The necessity of monitoring the more exotic pollutants such as acid gases, trace elements, metal carbonyls, and a multitude of organic compounds, will be determined as the gasification facility becomes more of a reality and the latest literature and research developments can be surveyed to evaluate the emission rates, biological significance, and monitoring techniques for these pollutants.

19916 (COO—5066-T10) **Fuel Gas Demonstration Plant Program: Small-Scale Industrial Project. Certificate of need.** (McKee (Arthur G.) and Co., Cleveland, OH (USA)). Dec 1978. Contract ET-78-C-01-2578;EW-78-C-02-5066. 447p. Dep. NTIS, PC A19/MF A01.

This Certificate of Need draft was prepared to meet new requirements as imposed by the Minnesota Energy Agency (MEA) since the original Erie/DOE contract was signed. The preparation of this document was authorized with the approval of the Certificate of Need contained in Contract Amendment No. A-005 of the Erie/DOE contract. With the issue of the Certificate of Need draft, Erie Mining Company considers this document requirement complete as it pertains to Phase I activities and delivered to DOE in accordance with Erie/DOE contract EW-78-C-02-5066 Appendix A, Part 3.I.F.5.

19917 (COO—5066-T11) **Fuel Gas Demonstration Plant Program: Small-Scale Industrial Project. Final report, Phase I.** (McKee (Arthur G.) and Co., Cleveland, OH (USA)). 19 Apr 1979. Contract ET-78-C-01-2578;EW-78-C-02-5066. 289p. Dep. NTIS, PC A13/MF A01.

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During the Erie internal alternate fuel review in 1976, the ERDA RFP for small scale demonstration plants was released and Erie responded. The basis of the contract proposal included design, construction and operation of a Demonstration Plant, which could be expanded to a full-sized industrial plant. The government specifically required the ability to handle Eastern, high-caking, high-sulfur coal. Erie's proposal was to utilize low-caking, low-sulfur coals with the Eastern coals optional. Phase I activity included selection of a gasifier and bids were solicited in October 1977. Babcock Contractors, Inc. was selected in February 1978, based on price and technical evaluation of the gasifiers. Some delay was experienced in selection activity due to late bids and clarification of bid proposals. Prior to selection activities, Erie, McKee and DOE participated in a gasifier inspection trip, visiting 11 plants in South Africa, Italy and Czechoslovakia. The operations, maintenance and designs included by the solicited vendors were evaluated and compared with site observations. Knowledge gained from the trip was used to evaluate the gasifiers and initiated various trade-off studies to resolve questionable areas. As design work progressed, delays were incurred with subcontractors due to late funding, delayed contractual approvals and disputes arising from DOE patent and proprietary data requirements. This final report is provided as a recapitulation and overall assessment of Phase I activities as performed in accordance with the Erie/DOE Contract and the agreed upon scope of work. Preliminary review of cost data in October 1978 resulted in Erie recommending and DOE agreeing to a reduced scope of work as project costs were projected to be considerably above the economic goals of the project. Erie has completed and delivered to DOE the contract deliverables as per the reduced scope of work and recommends that Erie and DOE mutually terminate the project.

19918 (COO—5066-T12(Vol.1)) **Fuel Gas Demonstration Plant Program: Small-Scale Industrial Project. Demonstration plant design manual, Phase I.** (McKee (Arthur G.) and Co., Cleveland, OH (USA)). Jan 1979. Contract ET-78-C-01-2578;EW-78-C-02-5066. 594p. Dep. NTIS, PC A25/MF A01.

The plant will utilize fixed bed, stirred, two stage gasifiers. The lower stage will be a standard gasifier configuration. The upper stage will be an undivided distillation section containing a slowly rotating stirrer which will move vertically through the bed. The bottom of the gasifier will contain a standard dry grate and will have lock hoppers to discharge the ash. This type of gasifier provides high coal utilization. It also distills the tars and oils from the coal in the upper zone at minimum temperatures, thereby providing minimum viscosity liquid fuels which can be used for the induration of iron ore pellets. The very hot bottom gases leaving the combustion zone, after passing through a cyclone to remove coal and ash dust can be used to generate steam. This steam is in addition to the steam generated in the water jacket of the lower zone which is used in the steam air blast to the bottom of the gasifier retort.

19919 (COO—5066-T12(Vol.2)) **Fuel Gas Demonstration Plant Program: Small-Scale Industrial Project. Demonstration plant design manual, Phase I.** (McKee (Arthur G.) and Co., Cleveland, OH (USA)). Jan 1979. Contract ET-78-C-01-2578;EW-78-C-02-5066. 343p. Dep. NTIS, PC A15/MF A01.

19920 (COO—5066-T13(Vol.1)) **Fuel Gas Demonstration Plant Program: Small-Scale Industrial Project. Demonstration plant design and economic evaluation, Phase I. Interim report.** (McKee (Arthur G.) and Co., Cleveland, OH (USA)). Dec 1978. Contract ET-78-C-01-2578;EW-78-C-02-5066. 253p. Dep. NTIS, PC A16/MF A01.

The Fuel Gas Demonstration Plant Program envisions a coal gasification facility to provide low Btu gas to the Erie Mining Company taconite pelletizing operations at Hoyt Lakes, Minnesota. Initially, it will consist of a Demonstration Plant which will be sized to supply 7.4 billion Btu (HHV) of fuel energy per day, which is

approximately 37% of the Erie Mining Company's daily energy requirement for the induration of pellets. The Demonstration Plant will be designed to permit ultimate expansion to a Commercial Plant capable of supplying the entire fuel gas requirement of the pellet plant. Erie Mining Company is one of the largest producers of iron ore pellets in the United States. Its plant consists of 27 shaft furnaces with an annual production capacity of 10.3 million tons. The furnaces now operate on natural gas and use ful oil as a backup energy supply. Fuel consumption is normally equivalent to 20 billion Btu per day. The contract arrangement between the Department of Energy and Erie Mining Company provides mutually advantageous opportunity and means for: employing coal gasification technology and equipment which is now commercially available, for production and use of low Btu gas in an industrial environment under actual operating conditions; identifying, defining and resolving problems and operational unknowns that have heretofore retarded industrial use of synthetic gas; establishing parameters for retrofitting existing industrial furnaces for use of low Btu gas; and determining and demonstrating the technical and economic feasibility of the proposed scheme.

19921 (COO—5066-T13(Vol.2)) **Fuel Gas Demonstration Plant Program: Small-Scale Industrial Project. Demonstration plant design and economic evaluation, Phase I. Interim report.** (McKee (Arthur G.) and Co., Cleveland, OH (USA)). Dec 1978. Contract ET-78-C-01-2578;EW-78-C-02-5066. 413p. Dep. NTIS, PC A18/MF A01.

19922 (COO—5066-T14(Vol.1)) **Fuel Gas Demonstration Plant Program: Small-Scale Industrial Project. Commercial plant design manual, Phase I.** (McKee (Arthur G.) and Co., Cleveland, OH (USA)). Jan 1979. Contract ET-78-C-01-2578;EW-78-C-02-5066. 620p. Dep. NTIS, PC A99/MF A01.

19923 (COO—5066-T14(Vol.2)) **Fuel Gas Demonstration Plant Program: Small-Scale Industrial Project. Commercial plant design manual, Phase I.** (McKee (Arthur G.) and Co., Cleveland, OH (USA)). Jan 1979. Contract ET-78-C-01-2578;EW-78-C-02-5066. 480p. Dep. NTIS, PC A20/MF A01.

19924 (COO—5066-T15(Vol.1)) **Fuel Gas Demonstration Plant Program: Small-Scale Industrial Project. Commercial plant design and economic evaluation, Phase I. Interim report.** (McKee (Arthur G.) and Co., Cleveland, OH (USA)). Dec 1978. Contract ET-78-C-01-2578;EW-78-C-02-5066. 338p. Dep. NTIS, PC A15/MF A01.

This report contains the description of a proposed Commercial Coal Gasification Plant to be built for Erie Mining Company at Hoyt Lakes, Minnesota. It also contains a Capital Cost Estimate for the plant and examines the economics of the plant operations. A Commercial Plant to utilize Eastern coal can be built at a capital cost of $95.8 million based on 1978 costs. This plant, utilizing Eastern coal costing $40 per ton, must sell low Btu gas at $6.64 per million Btu to produce a 12% internal rate of return. A Commercial Plant to utilize Western coal can be built at a capital cost of $81.6 million based on 1978 costs. This plant, utilizing Western coal costing $31 per ton, must sell low Btu gas at $6.39 per million Btu to produce a 12% internal rate of return.

19925 (COO—5066-T15(Vol.2)) **Fuel Gas Demonstration Plant Program: Small-Scale Industrial Project. Commercial plant design and economic evaluation, Phase I. Interim report.** (McKee (Arthur G.) and Co., Cleveland, OH (USA)). Dec 1978. Contract ET-78-C-01-2578;EW-78-C-02-5066. 353p. Dep. NTIS, PC A16/MF A01.

19926 (COO—5066-T16(Vol.1)) **Fuel Gas Demonstration Plant Program. Volume I. Demonstration plant.** (McKee (Arthur G.) and Co., Cleveland, OH (USA)). 1979. Contract ET-78-C-01-2578;EW-78-C-02-5066. vp. Dep. NTIS, MF A01.

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The objective of this project is for Babcock Contractors Inc. (BCI) to provide process designs, and gasifier retort design for a fuel gas demonstration plant for Erie Mining Company at Hoyt Lake, Minnesota. The fuel gas produced will be used to supplement natural gas and fuel oil for iron ore pellet induration. The fuel gas demonstration plant will consist of five stirred, two-stage fixed-bed gasifier retorts capable of handling caking and non-caking coals, and provisions for the installation of a sixth retort. The process and unit design has been based on operation with caking coals; however, the retorts have been designed for easy conversion to handle non-caking coals. The demonstration unit has been designed to provide for expansion to a commercial plant (described in Commercial Plant Package) in an economical manner.

19927 (COO—5066-T16(Vol.2)) **Fuel Gas Demonstration Plant Program. Volume II. Commercial plant.** (McKee (Arthur G.) and Co., Cleveland, OH (USA)). 1979. Contract ET-78-C-01-2578;EW-78-C-02-5066. 914p. Dep. NTIS, PC A99/MF A01.

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19928 (COO—5066-T16(Vol.4)) **Fuel Gas Demonstration Plant Program. Volume IV. Capital cost estimate.** (McKee (Arthur G.) and Co., Cleveland, OH (USA)). 1979. Contract ET-78-C-01-2578;EW-78-C-02-5066. 730p. Dep. NTIS, PC A99/MF A01.

19929 (DOE/FE—0002/79(1)) **Coal gasification. Quarterly report, January-March 1979.** (Department of Energy, Washington, DC (USA). Div. of Coal Conversion). Jan 1980. 68p. Dep. NTIS, PC A04/MF A01.

Progress in DOE-supported coal gasification pilot plant projects is reported: company, location, contract number, funding, process description, history and progress in the current quarter. Two support projects are discussed: preparation of a technical data book and mathematical modeling of gasification reactors. (LTN)

19930 (DOE/FE—0004/79(1)) **Coal demonstration plants. Quarterly report, January-March 1979.** (Department of Energy, Washington, DC (USA). Div. of Coal Conversion). Jan 1980. 73p. Dep. NTIS, PC A04/MF A01.

Progress in US DOE-supported demonstration plants for the gasification and liquefaction of coal is reported: company, contract number, process description and flowsheet, history and progress in the current quarter. Related projects involve coal feeders, lock hoppers, values, etc. for feeding coal into high pressure systems, coal grinding equipment and measuring and process control instrumentation. (LTN)

19931 (DOE/MC/12438—T1) **Conceptual design of a hot dirty gas control valve test facility. Final technical report.** (Rockwell International Corp., Canoga Park, CA (USA). Energy Technology Engineering Center). 1980. Contract AC21-79MC12438. 73p. Dep. NTIS, PC A04/MF A01.

The Energy Technology Engineering Center has conducted a study of hot dirty gas test facilities for the METC using requirements specified by METC for the testing of valves types destined for coal conversion plants. A variety of open- and closed-loop facility concepts, operating at both high (50 psig) and low (atmospheric) pressure, were investigated. A high-pressure, open-loop system was chosen as being the most reliable of the choices studied and most nearly meeting the test requirements. All equipment required for this loop is either of the off-the-shelf variety or a modification thereof, or is of contemporary state-of-the-art and characterized by ETEC experience with similar hardware. Combustor and sulfur dioxide removal systems are modifications of existing designs. Open loops are characterized by a low-capital/high-operating cost while the converse is true for the closed loop. The design confidence and operational reliability of a closed loop is judged much lower than for an open loop because of the complexity introduced by an indirect-fired heater and by a heat exchanger required to cool the process gas prior to compressor entry. The selected loop was designed to be erected out-of-doors, immediately adjacent to the ETEC's existing Transient Test Facility (TTF), which would provide the necessary utilities, manpower, and control room. Based upon this approach, the design and construction cost for the selected facility is $3.5 million. The operating costs for two 2000-hour test programs ranges from $3 million to $4.5 million. The lower number assumes concurrent testing at TTF and the higher number assumes operation of the hot dirty gas loop only. The construction costs are based on raes predicted for the midpoint of construction (assumed December 1981), and oversized exhaust clean-up equipment.

19932 (DOE/MC/14380—T1) **Prediction and measurement of optimum operating conditions for entrained coal gasification processes. Quarterly technical progress report, No. 1, 1 November 1979-31 January 1980.** Smoot, L.D.; Hedman, P.O.; Smith, P.J. (Brigham Young Univ., Provo, UT (USA). Dept. of Chemical Engineering). 15 Feb 1980. Contract AC21-80MC14380. 71p. Dep. NTIS, PC A04/MF A01.

This report summarizes work completed to predict and measure optimum operating conditions for entrained coal gasifications processes. This study is the third in a series designed to investigate mixing and reaction in entrained coal gasifiers. A new team of graduate and undergraduate students was formed to conduct the experiments on optimum gasification operating conditions. Additional coal types, which will be tested in the gasifier were identified, ordered, and delivered. Characterization of these coals will be initiated. Hardware design modifications to introduce swirl into the secondary were initiated. Minor modifications were made to the gasifier to allow laser diagnostics to be made on an independently funded study with the Los Alamos Scientific Laboratory. The tasks completed on the two-dimensional model included the substantiation of a Gaussian PDF for the top-hat PDF in BURN and the completion of a Lagrangian particle turbulent dispersion module. The reacting submodel is progressing into the final stages of debug. The formulation of the radiation submodel is nearly complete and coding has been initiated. A device was designed, fabricated, and used to calibrate the actual Swirl Number of the cold-flow swirl generator used in the Phase 2 study. Swirl calibrations were obtained at the normal tests flow rates and at reduced flow rates. Two cold-flow tests were also performed to gather local velocity data under swirl-

ing conditions. Further analysis of the cold-flow coal-dust and swirl test results from the previous Phase 2 study were completed.

19933 (FE—1207-T7) **Bi-Gas Pilot Plant Program. Annual report, July 1, 1978-June 30, 1979.** (Phillips Petroleum Co., Homer City, PA (USA)). Sep 1979. Contract EX-76-C-01-1207. 87p. Dep. NTIS, PC A05/MF A01.

The char eductor tests using coal, were continued. Interpretation and evaluation of the responses of the new instruments for measuring the pressure increase across each char eductor and the pressure drop from the outlet of each eductor to the gasifier continued during the tests. It appeared that the new instrumentation could be used to give a valid char flow/no-flow indication. Thirteen gasifier tests were conducted with the following major objectives: (1) achieve a 24-hour, steady-state period of operation with continuous slag tapping; (2) build a level of char in the char feed vessel prior to the initiation of char feed; (3) build a level of coal in the coal cyclone vessel prior to the initiation of coal feed; (4) achieve a material balance around the gasifier; (5) continue efforts to measure and control coal and char feed rates; (6) determine the effects of feeding larger size consists of coal to the gasifier. Montana Rosebud subbituminous coal from the Colstrip mine was used as the gasifier feed in all tests. The gasifier was operated at 750 psig. During each test, supplementary natural gas was introduced with the char being fed to Stage I of the gasifier with nitrogen being fed with the oxygen during all but the last two tests. Ground limestone was fed with the coal to act as a flag fluxing agent during only the first four tests. The individual tests are described. (LTN)

19934 (FE—1207-T9) **Gas generator research and development. Bi-gas process: solids feeding, metering, and control at the Bi-Gas Pilot Plant.** (Bituminous Coal Research, Inc., Monroeville, PA (USA); Phillips Petroleum Co., Homer City, PA (USA)). Oct 1979. Contract EF-77-C-01-1207. 128p. Dep. NTIS, PC A07/MF A01.

This report discusses the problems of transferring coal and char solids from their respective high pressure collection vessels to the BI-GAS gasifier. Four aspects of these problems discussed in detail are: solids flow motivation, solids flow detection, solids flow measurement, and solids flow control. Both the coal and char feeding systems exhibited frequent plugging problems when attempting to feed solids in the as-designed mode (with a level of solids in the feeding system). The Argonne acoustic flow monitor, the differential pressure instrumentation across the solids feed legs, eductors, and nozzles, the Thermal flow meters, and the educator heat belance method all responded to the initiation and termination of solids flow through the feed legs. The Argonne monitor and the differential pressure instrumentation usually responded very quickly (within 1 to 5 sec) to changes in solids flow rates. Periodic fluctuations and occasional inconsistent signals precluded the possibility of using these devices to automatically shut down the gasifier or a char burner when char flow is suddenly stopped. The inability to quickly detect the loss of char flow to the gasifier severely limits the ability of the BI-GAS Pilot Plant project to evaluate the BI-GAS process as a commercially viable method of converting coal to high-Btu gas. The Thermal flow meters and the eductor heat balance thermocouples responded only slowly to changes in solids flow rates (1 to 15 minutes). These two methods of solids flow measurement/detection would be best suited to long-term, steady-state flow measurement.

19935 (FE—1207-T10) **Gas generator research and development BI-GAS process. Stage I temperature measurement.** (Bituminous Coal Research, Inc., Monroeville, PA (USA); Phillips Petroleum Co., Homer City, PA (USA)). Oct 1979. Contract EF-77-C-01-1207. 42p. Dep. NTIS, PC A03/MF A01.

This is one of a series of reports describing specific BI-GAS pilot plant topics. This report focuses on the efforts taken to measure temperature within Stage I (the slagging section) of the 2-stage, entrained-bed, high pressure (1500 psig max), oxygen blow, and ash slagging gasifier. The control of the BI-GAS gasifier has been largely predicted on the temperature within Stage I. There has been significant difficulty, however, in developing the equipment needed to reliably measure this temperature. Two types of temperature measuring systems were tested during the 41 gasifier tests encompassed in this report: thermocouples and an infrared radiometer. Experience in utilizing these temperature measuring systems is discussed and analyzed. One of the more discouraging trends was that the failure rate of the Stage I thermocouples was not significantly reduced during the 41 gasifier tests encompassed in this report. The response of an infrared radiometer unit, selected as an alternative Stage I temperature measuring device was considerably more rapid than that of the thermocouples, and use of the radiometer did not require that part of the instrument be in contact with the hostile Stage I environment. A modified radiometer unit, employing the two color technique, was scheduled to be used during gasifier Test G-8. With the modified unit, Stage I temperature measurements should be obtainable despite the presence of some absorbing material in the optical path. It is recommended that both the testing of new material to protect the Stage I thermocouples and the ongoing research with the infrared radiometer unit be continued. It is recommended that studies be made to see how these efforts can be expanded outside the pilot plant.

19936 (FE—1784-57(Suppl.)) **Program to discover materials suitable for service under hostile conditions obtaining in equipment for the gasification of coal and other solid fuels. Quarterly progress report, July 1, 1979-September 31, 1979.** (Metal Properties Council, Inc., New York (USA)). 12 Nov 1979. Contract EX-76-C-01-1784. 142p. Dep. NTIS, PC A07/MF A01.

In July 1976, Southwest Research Institute began work on Phase V (Mechanical and Physical Properties of Materials) of a multiphase program on materials for coal conversion applications instituted by the Metal Properties Council, Inc. A detailed report of the results obtained under Phase V through December 1978 is presented here. A major effort under this program was the development of a creep-rupture and low-cycle-fatigue test facility capable of materials testing in a high-temperature, pressurized coal gas environment. A description of this facility is included in this report. Mechanical and physical properties tests were conducted on ten materials and six weldments, and included tests in both air and a pressurized coal gasification environment. Of the various tests performed, extensive results are presented from stress-rupture tests conducted in both air and coal gas, and tensile and impact tests conducted in air after various air and coal gas pre-exposures. Limited results are included from low-cycle-fatigue and physical properties (melting range, density, specific heat, and thermal expansion) determinaions.

19937 (FE—1793-40) **Coal feeder development. Draft Phase II report.** (Foster-Miller Associates, Inc., Waltham, MA (USA)). Jun 1978. Contract EX-76-C-01-1793. 188p. Dep. NTIS, PC A09/MF A01.

The feeder concepts selected for continued development, on the basis of the Phase I program effort, were translated into working hardware and tested. These feeder concepts included: a linear pocket feeder, a centrifugal feeder, a fluidized piston feeder, and a compacted coal plug feeder. At the conclusion of bench scale testing, all four feeder concepts were determined to be technically feasible. However, because of funding limitations, it was necessary to eliminate one of the four feeder concepts. The development of the plug feeder concept was suspended. The basic considerations influencing this decision included the high power requirements of the device, limited flexibility in terms of possible applications, and duplication of effort with respect to other feeder development programs. The performance of the linear pocket feeder prototype met or exceeded all Phase II performance goals. Feed rates in excess of 5 tons per hour have been achieved at pressure differentials to 500 psig. Continued development of the linear pocket feeder is recommended in Phase III of the program. The centrifugal feeder has met or exceeded all Phase II performance goals. The prototype feeder has fed pulverized coal at a rate in excess of 1-1/2 ton per hour against a 200 psig back pressure. The centrifugal feeder concept is recommended for Phase III development. The prototype piston feeder has fed coal at rates ranging from 250 pounds per hour at 600 psi to 110 pounds per hour at 900 psi. Additional development of the piston feeder is required to achieve specified Phase II goals. Further Phase II level development of the piston feeder is recommended with emphasis on improving valve performance.

19938 (FE—2006-16) **Applied research and evaluation of process concepts for liquefaction and gasification of western coals. Quarterly progress report, April-June 1979.** Wiser, W.H. (Utah Univ., Salt Lake City (USA). Dept. of Mining, Metallurgical and Fuels Engineering). Oct 1979. Contract EX-76-C-01-2006. 88p. Dep. NTIS, PC A05/MF A01.

The research reported herein is all of fundamental importance in summport of either a process for development of liquefaction of coal, catalysis or some related research. In particular, the projects are intended to apply the expertise developed by the coal research team at the University of Utah to problems in four general areas: evaluation of process concepts in relation to liquefaction and gasification of coal; catalysis studies of fundamental importance in liquefaction and gasification of coal; studies of fundamental principles involved in processes for liquefaction and gasification of coal; and properties of coal and coal conversion products of significance in liquefaction and gasification of coal. Research Highlights are: (1) a reaction pathway for hydrodeoxygenation of oxygen containing species is proposed based on studies of model compounds. Reaction pathways that can lead to coke formation and catalyst deactivation and identified. (2) Studies on the hydrodesulfurization of thiophene support the Kolbe mechanism. (3) Preasphaltenes produced at low conversions have been characterized. The heteroatom content is similar to that of the original coal and less than that of asphaltenes and oils. The carbon aromaticity is 0.6 to 0.7, but the molecules contain only 1-2 aromatic rings per condensed ring system.

19939 (FE—2012-091) **Pipeline gas demonstration plant, Phase I. Quarterly technical progress report, December 1979-February 1980.** Eby, R.J. (Illinois Coal Gasification Group, Chicago (USA)). Mar

1980. Contract EF-77-C-01-2012. 50p. Dep. NTIS, PC A03/MF A01.

Work has continued in the following Tasks previously opened in Phase I, Stage 1 of the Pipeline Gas Demonstration Plant Program: Demonstration Plant Process Design, Site Evaluation and Selection, Demonstration Plant Environmental Analysis, Materials and Licenses, Demonstration Plant Definitive Design, Technical Support, Long Lead Procurement List, and Project Management. During this past quarter, the following Major Contract Deliverables were submitted to DOE: Task VI Network Analysis Document, Addendum 3; Configuration Management Plan, Revision 3; and Reliability and Quality Assurance Plan, Revision 2. The major work activity has been the continuing effort to complete Demonstration Plant Process Design. The completion of this effort will provide Process Design Baseline Packages for the fourteen process areas which are the bases for the Demonstration Plant Definitive Design. The final Task II product will be the two Major Contract Deliverables: Demonstration Plant Process Design Report, and the Demonstration Plant Design Analysis Report. Also, significant effort has been expended in providing data and documentation for the proposed Contract Modification M020 and the DOE Contract Performance Evaluation, Supplement 1. All work in other tasks has progressed satisfactorily, within the constraint of available funds, in support of the Demonstration Plant Program.

19940 (FE—2286-52) **Preparation of a coal conversion systems technical data book. Quarterly report, May 1-July 31, 1979.** (Institute of Gas Technology, Chicago, IL (USA)). Apr 1980. Contract EX-76-C-01-2286. 215p. Dep. NTIS, PC A10/MF A01.

The effect of temperature on salting-out coefficients for ammonia, carbon dioxide, and hydrogen sulfide in the NH_3-CO_2-H_2S-H_2O system is discussed. In addition, the salting-out coefficients of a wide variety of gases by sodium chloride solution at 25°C are tabulated. The report on combustion characteristics of low and medium Btu gases has been revised. Comments on the previous report have been considered in this revision. Results of experimental evaluations of low-Btu gases on utility boiler type burners, industrial burners and pollutants emission from the combustion are briefly stated in this report. The IGT formula for calculating the heating value of coal from its composition has been applied to 1778 coal analyses of HYGAS pilot plant samples. The calculated and observed values are in close agreement. The physical and thermodynamic properties of naphthalene and tetralin are tabulated in both the SI and English units. Resource Engineering, Inc. of Lexington, MA, was awarded a subcontract working on coal storage, preparation and handling in Data Book format. The outline of the proposed work is included in this report. The yields of methane and ethane from Fischer assay are correlated with H/C, O_2%, and C% for various coal groups (from low rank lignite to high rank anthracite). A revised write-up on environmentally related permits and reports required for construction of a coal conversion plant is presented. The complex process and length of time involved for obtaining the permits and reports are discussed. An outline of the proposed study on methanation of synthesis gas is being circulated for review and comments.

19941 (FE—2570-24) **Coal gasification project, Douglas site, Pike County, Kentucky. Annual report, April 1978-March 1979.** Puffer, G.R. (Pike County Coal Gasification Project, Pikeville, KY (USA); Mason and Hanger-Silas Mason Co., Inc., Lexington, KY (USA)). Oct 1979. Contract EF-77-A-01-2570. 46p. Dep. NTIS, PC A03/MF A01.

The objective of this work, primarily, is to use coal gasifiers in conjunction with an energy plant using state of the art equipment as the sole energy system to support a Governmental-Commercial development with provisions to furnish low Btu gas to industrial users in the future. Secondarily, the objective is to provide a demonstration facility serving to collect technical, environmental and economic data on a low Btu gasification system. All phases of the program, i.e., design, fabrication, installation, and up to three years of operation, will be evaluated to furnish data for the basis of analyzing the utilization of coal gasification for similar applications. The initial concept of the project did not extend beyond the design, installation, and operation of a basic energy plant consisting of gas producers, boilers, chillers, and the required ancillary pumps, motors, etc. necessary to provide hot and/or chilled water for heating and cooling with the surplus producer gas, if any, being available for sale to possible future industrial users. However, immediately after the signing of the Cooperative Agreement, the decision was made by the Federal Agency then in charge, the United States Energy Research and Development Administration (ERDA), to add the design of a gas cleanup system to the project with the understanding that future modifications to the Cooperative Agreement would be made to enable the construction of this unit. The design of the cleanup system was included at this time in order that the costs and the physical space requirements could be more accurately estimated and the future final decisions regarding the additional funding required might proceed in an orderly manner.

19942 (FE—2702-8) **Kinetics and mechanisms of catalytic hydroliquefaction and hydrogasification of lignite. Quarterly report, July-September 1979.** Weiss, A.H.; Kranich, W.L. (Worcester Polytechnic Inst., MA (USA)). 1979. Contract EF-77-S-01-2702. 8p. Dep. NTIS, PC A02/MF A01.

Several successful runs on hydrogenation of a 20% slurry of lignite in anthracene oil have been made at 425°C in a CSTR. At constant concentration of uncoverted coal solids, the rate of reaction appears from very limited data to be independent of hydrogen pressure over a total pressure range of 800 to 1600 psig. Rate also appears to be independent of concentration of Co-Mo catalyst over the range of 0.8% to 2.0% of total charge. If these results can be reproduced and extended, this may indicate that over these ranges, hydrogen is supplied and activated by the catalyst at a rate well in excess of that at which it can be utilized by the slower hydroliquefaction reactions. Present limitations on reaction conditions imposed by the narrow range of the pump should be removed by delivery of a Hills McCanna pump of the type successfully used at Grand Forks Energy Technology Center.

19943 (FE—2777-10) **Exxon Catalytic Coal Gasification Process Development Program. Annual technical progress report, July 1, 1978-June 30, 1979.** (Exxon Research and Engineering Co., Baytown, TX (USA)). Oct 1979. Contract ET-78-C-01-2777. 142p. Dep. NTIS, PC A07/MF A01.

The Exxon Catalytic Coal Gasification Development Program began in July 1978 and is planned to be completed in June 1981. The program is a coordinated effort involving bench scale R and D, operation of a one-ton-per-day Process Development Unit (PDU), and engineering support. This work is aimed at advancing the catalytic coal gasification technology through the development stage to make it ready for further scale-up in a large pilot plant. One of the major objectives of the program is to demonstrate the feasibility of the integrated process which includes gasification, gas separation, and catalyst recovery. This integrated system will be operated at commercial design conditions feeding bituminous Illinois No. 6 coal catalyzed with potassium hydroxide. This operation will demonstrate the feasibility of the catalytic coal gasification process in integrated operation and will ready the technology for scale-up to the larger pilot plant stage. The conceptual commercial CCG process will be defined. This work will include a flow diagram for the process, heat and material balances, and a definition of key process features unique to catalytic coal gasification, including the catalyst addition, gasification, and catalyst recovery sections. Progress for the period is reported with emphasis on bench-scale experiments, PDU construction and checkout, data acquisition system for the PDU, catalyst recovery studies, acid gas removal, system analysis and materials evaluation.

19944 (FE—3044-T6) **Cryogenic methane separation/catalytic hydrogasification process analysis.** Cassano, A.A.; Hilton, M.F.; Li, T.C. (Air Products and Chemicals, Inc., Allentown, PA (USA)). 15 May 1979. Contract ET-78-C-01-3044. 96p. Dep. NTIS, PC A05/MF A01.

The objective of this program is to recommend the most attractive combinations of acid gas removal and cryogenic methane separation for both the Exxon Catalytic Coal Gasification and the Rockwell Hydrogasification processes currently undergoing development supported by DOE. This program is comprised of the following three tasks: screening, to define the most promising integration scheme for each gasification process; developing a process flowsheet, heat and material balance, P and ID, equipment specifications, utility summary, and plot plan for the selected scheme of each process; and preparing the detailed economics and issuing the final report. This interim report documents the results of the Task I study. The acid gas removal processes under study included Selexol, Rectisol, and Benfield HiPure for the Exxon CCG process; MEA, DEA, improved DGA, and Sulfinol for the Rockwell Hydrogasification process. The evaluations were performed using data from the prime coal gasification contractors and from the vendors of proprietary acid gas removal processes. This information, combined with Air Products' in-house capabilities in acid gas processes and cryogenic separation, allowed preparation of process designs and cost estimates for each of the integrated schemes. The gas treating cost was then determined for each combined system. The design criteria used in preparing the process designs are listed. The basis of economics for the capital cost and the gas treating cost estimate are also given.

19945 (FE—3044-T7) **Cryogenic methane separation/catalytic hydrogasification process analysis. First quarter report, 15 October 1978-15 January 1979.** (Air Products and Chemicals, Inc., Allentown, PA (USA)). 16 Jan 1979. Contract ET-78-C-01-3044. 19p. Dep. NTIS, PC A02/MF A01.

Efforts have been directed towards identifying the most attractive acid gas removal systems based on preliminary screenings. The program is behind schedule primarily due to delays in receiving from, and agreeing with, the prime coal gasification contractors, as to the design specifications to be used for the Air Products Acid Gas, Cryogenic Separation process. Since receiving this data, efforts

have been intensified so as to bring the program back onto schedule. Lines of communication have been established between Air Products and Chemicals, Inc. and Exxon, Rockwell International, Lotepro, Shell Oil and Benfield. Using proprietary information obtained from the respective vendors of the Benfield and Rectisol acid gas removal processes, preliminary cost estimates have been completed for the Exxon CCG process. Several sets of computer simulations, for different acid gas removal configurations, for the Selexol process have been developed to optimize methane recovery and utility savings. As dictated by the flow of information, the evaluation of acid gas removal processes for the Rockwell SNG process is four to six weeks behind the acid gas removal studies for the Exxon process. For the Rockwell case, Sulfinol, DEA and DGA, acid gas removal processes are being evaluated.

19946 (FE—3240-T4) **Shift conversion and methanation in coal gasification: bench-scale evaluation of a sulfur resistant catalyst. Quarterly progress report, 1 October-31 December 1979.** Wood, B.J.; Sheridan, D.; McCarty, J.G.; Wise, H. (SRI International, Menlo Park, CA (USA)). 18 Jan 1980. Contract ET-78-C-01-3240. 16p. Dep. NTIS, PC A02/MF A01.

A bench-scale, long-term study is in progress of the deactivation rate of a new methanation catalyst which in earlier laboratory measurements had demonstrated both higher specific methanation activity and resistance to sulfur poisoning. The measurements are carried out in two parallel, fixed-bed reactors exposed to a feed stream ($H_2/CO = 3.1 +- 0.1$, and 1.5 ppM H_2S) at a space velocity of 6700 hr^{-1} and a total gas pressure of 50 psig. One of the reactors contains the new catalyst, Ir-promoted nickel on alumina ($Ir/Ni/Al_2O_3$); the other, for the purpose of comparison, a commercial analyst (Ni/Al_2O_3). Each of the catalyst samples was diluted with Al_2O_3 at a ratio of 5/1. The deactivation rates were examined in terms of the loss in conversion with exposure time to the syn gas mixture, the change in temperature distribution along the axis of the catalyst bed, and the breakthrough of hydrogen sulfide in the product stream. The results demonstrated significant differences between the two catalysts under study. For the same mass of catalyst and Al_2O_3 diluent the $Ir/Ni/Al_2O_3$ samples exhibited a considerably longer life than Ni/Al_2O_3. After 800 hours of operation the Ni/Al_2O_3 has lost nearly 99 percent of its initial activity, while the activity loss amounts to only 25 percent in the case of $Ir/Ni/Al_2O_3$. However the Al_2O_3 used as a diluent in the catalyst bed was not chemically inert, but interacted with H_2S in the feed stream. As a result an unequivocal, quantitative interpretation of the data in terms of effective lifetimes of the two catalysts under study is not possible.

19947 (SAND—80-0482) **Instrumentation and process control development for in situ coal gasification. Twentieth quarterly report: September-November 1979.** Glass, R.E. (Sandia Labs., Albuquerque, NM (USA)). Apr 1980. Contract EY-76-C-04-0789. 25p. Dep. NTIS, PC A02/MF A01.

The second phase of the Hanna IV in situ coal gasification test, Hanna IV-B, which was initiated on April 20, 1979, was completed on October 4, 1979. Sandia National Laboratories provided support by fielding and monitoring diagnostic and remote monitoring instrumentation techniques. During the final gasification stage, 765 tons of coal were reacted involving 17,000 cubic feet. The Hoe Creek III experiment conducted by Lawrence Livermore Laboratories began on August 15, 1979, and was terminated on October 10, 1979. The purpose of the experiment was to test the drilled borehole linking concept. Sandia National Laboratories' involvement consisted of fielding and monitoring both an inverted thermocouple and a surface electrical resistivity network. The inverted thermocouple was successfully tested and provided thermal data from beneath the burn zone. A real time analysis procedure for the electrical resistivity technique was implemented at Hoe Creek III. Unfortunately, there was insufficient change in the data for this to have been a useful diagnostic. Efforts are continuing to identify the reason for this lack of response.

19948 (UCRL-Trans—11578) **Operating experience of an underground gas generator using a steam-air flow.** Yudin, I.D.; Revva, M.K. Mar 1980. Translated from Problemy podzemnoi gasitikatsii v kuzbasse; Kemerobo, No. 2 (1967), pp 103-105. 5p. Dep. NTIS, PC A02/MF A01.

Considering the experimental results as a whole, the use of steam in coal gasification in the Yuzhno-Abinsk region is extremely promising. The data indicate the need for special laboratory studies on the use of a steam-oxygen flow for underground coal gasification in the Kuznetsk Basin. The individual experiments are described briefly and tables of fuel gas composition and calorific value are included. (LTN)

19949 HYGAS Process to produce pipeline gas from coal. Chicago, IL; Institute of Gas Technology (1980). 23p. (NP—24360).

The process has evolved from 35 uninterrupted years of coal gasification R and D at IGT. Specific HYGAS work was begun about 1964 and now totals about 1.8 million man-hours, has cost approximately $83 million, and has produced numerous patent disclosures. The HYGAS pilot plant has been operational for 8 years. It has a design capacity of 80 tons of coal daily to produce 1.5 million standard cubic feet (SCF) of pipeline-quality gas (SNG) daily. The HYGAS pilot plant has operated for more than 10,000 h, much of that time as an integrated facility feeding only oxygen, steam, and coal into the reactor system. The HYGAS pilot plant has operated on lignite, subbituminous, and bituminous coals. The plant has processed a total of more than 22,700 tons of coal. The HYGAS pilot plant has produced about 267 billion Btu of gas (equivalent to 44,500 bbl oil). The HYGAS Process is economically superior to those gasification processes with which HYGAS has been compared, that are contending for commercialization. The HYGAS Process is the only coal gasification process now in US demonstration design status that is totally owned by the United States government. The HYGAS Process, logically, will include in its future course of development the construction of a demonstration facility whose reactor would be built to full commercial size. Expansion to a commercial facility would require no further scale-up, technology development, or risk, thus greatly reducing future problems of financing.

19950 Process for control of pollutants generated during coal gasification. Frumerman, R.; Hooper, H.M. (to Dept. of Energy). US Patent 4,175,929. 27 Nov 1979. Filed date 29 Aug 1978. 6p.

PAT-APPL-937,903.

The present invention is directed to an improvement in the coal gasification process that effectively eliminates substantially all of the environmental pollutants contained in the producer gas. The raw producer gas is passed through a two-stage water scrubbing arrangement with the tars being condensed essentially waterfree in the first stage and lower boiling condensables, including pollutant laden water, being removed in the second stage. The pollutant-laden water is introduced into an evaporator in which about 95% of the water is vaporized and introduced as steam into the gas producer. The condensed tars are combusted and the resulting products of combustion are admixed with the pollutant-containing water residue from the evaporator and introduced into the gas producer.

19951 Solid handling valve. Williams, W.R. (to Dept. of Energy). US Patent 4,173,327. 6 Nov 1979. Filed date 1 Jun 1977. 6p.

PAT-APPL-802,328.

The present invention is directed to a solids handling valve for use in combination with lock hoppers utilized for conveying pulverized coal to a coal gasifier. The valve comprises a fluid-actuated flow control piston disposed within a housing and provided with a tapered primary seal having a recessed seat on the housing and a radially expandable fluid-actuated secondary seal. The valve seals are highly resistive to corrosion, erosion and abrasion by the solids, liquids, and gases associated with the gasification process so as to minimize valve failure.

19952 Information approach to examining developments in an energy technology: coal gasification. Frame, J.D. (Computer Horizons, Inc., Washington, DC); Baum, J.J.; Card, M. *J. Am. Soc. Inf. Sci.;* **30**: No. 4, 193-201(Jul 1979).

Developments in coal gasification research are investigated by examining the coal gasification literature, which is broadly defined to include journal articles, research reports, engineering proceedings, and patents. A substantial number of items were found for 1974, 1975, and the early part of 1976 (N = 1461). The coal gasification literature has experienced explosive growth in recent years, trebling in size between 1972 and 1974. While some of this growth may be associated with the recent energy crisis, in large measure, it appears to be associated with the establishment of benchscale and pilot plant coal gasification operations in the late 1960s and early 1970s. Most published coal gasification research is produced by the US private sector (38.7%), followed by the US government (24.0%), foreign researchers (20.5%), universities (8.5%), and unknown (8.5%). This study suggests that technologies which are government supported and reported in the public domain are - like most scientific areas - good candidates for bibliometric inquiries. These inquiries allow for relatively economic, efficient, and reliable examinations of national research activity in given scientific and technological areas.

19953 Correlation of vapor-liquid equilibria of aqueous condensates from coal processing. Mason, D.M.; Kao, R. Chicago, IL; Institute of Gas Technology (1979). 33p. (CONF-791063—2).

From Conference on thermodynamics of aqueous systems with industrial applications; Washington, DC, USA (22 Oct 1979).

Vapor-liquid equilibria in the NH_3-CO_2-H_2S-H_2O system is of importance in the processing of coal for production of gaseous and liquid fuels. Direct vapor-liquid equilibrium data are available for only limited ranges of temperature and composition and must be supplemented by correlation with models utilizing other data. Data on the solubility of each of the component gases in water and data on their ionization constants have been reviewed. Correlations for the salting out of these and other gases by the dissolved electrolytes have been developed. Work on the NH_3-CO_2-H_2O ternary and on the quaternary system is still in progress.

19954 (UCRL-Trans—11561) **Simulation model for the production of hot and reducing gases in the resonant pipe.** Rolf, L. Translated from *Glueckauf-Forschungsh.*; 39: No. 5, 198-206(1978). 39p. Dep. NTIS, PC A03/MF A01.

The suggestion to gasify coal in a resonant pipe was made before 1950 and was seized upon in the Institute for Chemical Engineering, since it had been found that the kinetics of the reaction processes in the resonant pipe made possible very high specific flow rates of material with nearly total conversion. Besides the practical problems that arise in other dust gasification processes, such as metering of materials, discharging reaction gases, guiding slag, etc., the problems involved in the commercial implementation of this reaction involve the extremely large number of influencing parameters that have to be taken into consideration in managing the process and whose interactions due to the non-steady-state reaction can scarcely be estimated. This resulted in the setting of a goal to carry out investigations of the influence of raw materials, the reactor and the operating conditions on the process and to create a simulation model of the process. That model should reproduce the dynamic course of the reaction and make possible a calculation of the time variations of the process's state variables as a function of the parameters that are introduced. In that way, deeper knowledge about the behavior of the process can be obtained. In addition, precalculations can be performed with the aim of achieving an engineering and economic optimization of the gasification process in the resonant pipe.

LIQUEFACTION

REFER ALSO TO CITATION(S) 19895, 19896, 19897, 19903, 19904, 19930, 19938, 19940, 19942, 19953, 19980, 20249, 20542, 20916

19955 (BNL—27279) **General quantitative model for coal liquefaction kinetics: the thermal cleavage/hydrogen donor capping mechanism.** Gangwer, T. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract EY-76-C-02-0016. 82p. Dep. NTIS, PC A05/MF A01.

A mechanism for coal liquefaction, based on the concept of thermal cleavage-hydrogen capping donor complexes, is proposed and the quantitative agreement between the derived rate laws and the kinetic data obtained from fifteen publications is presented. The mechanism provides rate laws which describe the preasphaltene, asphaltene, oil and gas time/yield curves for the coal liquefaction process. A simplistic dissolution model is presented and used to relate the proposed mechanism to the experimentally observed products. Based on the quality of the mechanistic fit to the reported coal liquefaction systems, which cover a diverse range of reaction conditions, coal types and donor solvent compositions, it is proposed that the donor solvent/thermal bond cleavage/hydrogen capping mechanism provides a good, quantitative description of the rate limiting process. Interpretation of the rate constant/temperature dependencies in terms of transition state theory indicates formation of the activated complex can involve either physically or chemically controlled steps. A uniform free energy of activation of 52 kcal was found for the diverse liquefaction systems indicating a common transition state describes the reactions. Thus the proposed mechanism unifies the diverse liquefaction kinetic data by using a set of uniform reaction sequences, which have a common transition state, to describe the conversion chemistry. The mechanism thereby creates a common base for intercomparison, interpretation and evaluation of coal conversion for the broad range of processes currently being investigated in the liquefaction field.

19956 (CONF-790749—, pp 2-17) **Department of Energy overview.** Neal, J.W. (Department of Energy, Germantown, MD). Dec 1979.

From Conference on advanced materials for alternate fuel capable directly fired heat engines; Castine, ME, USA (30 Jul 1979).

The research strategy of the US DOE in the area of heat engines and coal-derived liquid fuels is outlined. The general idea is to develope stationary engines or turbines which will work with minimally upgraded coal-derived liquids (i.e., comparable to residual fuel from petroleum, but with more nitrogen, lower H/C ratio, possibly higher ash content and more alkali metals). Some engine development is required to burn these fuels and keep NO/sub x/ invision within regulations. The major intended use for these fuels is for utility peaking power where they would substitute for natural gas or fuel oils. Additional features of the strategy are waste heat utilization by the use of co-generation or organic Rankine bottoming cycles. Coal gasification is discussed briefly. (LTN)

19957 (CONF-790749—, pp 28-44) **Alternate fuels in directly fired heat engines.** Thomas, R.L.; Conta, L.D. Dec 1979.

From Conference on advanced materials for alternate fuel capable directly fired heat engines; Castine, ME, USA (30 Jul 1979).

Research implications of future alternatives for combustion engine, base load applications focus on the need to assure component reliability and low maintenance costs while improving overall efficiency to offset increased costs inherent in the complexity of producing and distributing alternate fuels. Based on projected fuel costs, low-Btu gas, shale liquids, synthetic natural gas and raw coal liquid distillates appear to be leading near term contenders for base- load turbine, diesel, and gas engine applications as sources of petroleum-based engine fuels diminsh. Research directed at making these fuels available in sufficient quantity and quality to permit their use in an efficient and environmentally acceptable manner is vitally needed. Research efforts to date have identified several key areas to be resolved for each of these fuels; these are described in the paper. Shale oil appears to be the most reasonable choice for early application, but the problems associated with large scale production of shale make the early development of coal-derived liquids and gases of vital importance. With respect to engine development, high temperature materials and protective coatings will undoubtedly play a major role in permitting engines and turbines both to develop higher efficiencies and to survive in the more hostile atmosphere associated with less refined and alternate fuels. Integrated gasifier-turbine, combined-cycle plants appear economically attractive compared to other alternative fuel options for the gas turbine. Since the components have already been proven individually, early application of this technology should be planned, with research and development emphasis on combustor development, load-following characteristics, and gas purification. (LTN)

19958 (CONF-790749—, pp 45-79) **Economic and market potential for SRC-II products.** Schmid, B.K.; Koenig, J.C.; Jackson, D.M. (Gulf Mineral Resources Co., Denver, CO). Dec 1979.

From Conference on advanced materials for alternate fuel capable directly fired heat engines; Castine, ME, USA (30 Jul 1979).

The SRC-II process has shown considerable promise in pilot plant work, and plans are now being made to demonstrate the process using commercial size equipment. The products (both liquid and gas) from a future, large-scale, commercial plant are expected to have an overall selling price of $3.50 to 4.00 per million Btu (fourth quarter 1978 basis). The major product of the primary process is distillate fuel oil of less than 0.3% sulfur for use at the outset largely as a non-polluting fuel for generating electrical power and steam, especially in the east where utilities and industry are presently using petroleum products. In such applications, SRC-II fuel oil is expected to become competitive with petroleum-derived fuels within the next decade. During this period, SRC-II fuel oil should be economically attractive compared to coal combustion with flue gas desulfurization in electric utility and industrial boilers, particularly in the major metropolitan areas. For the longer term, the major growth opportunity for SRC-II fuel oil in the generation of electric power will probably be through advanced combustion turbine units with heat recovery boilers (combined cycle units). Several by-products, some more valuable for a feedstock than as a fuel, are discussed: high Btu gas, light hydrocarbons (ethane, propane), naphtha, diesel and gas turbine fuels. For many of these applications, the fuel oil and other products from the SRC-II process would displace high quality petroleum fractions, which could then be used for production of diesel fuels, jet fuels, home heating oil, and gasoline by conventional refinery processes.

19959 (CONF-790749—, pp 80-91) **H-Coal: a status report.** Wellman, P. (Ashland Oil, Inc., KY). Dec 1979.

From Conference on advanced materials for alternate fuel capable directly fired heat engines; Castine, ME, USA (30 Jul 1979).

The H-Coal process converts coal by direct catalytic hydrogenation to substitute for petroleum ranging from a low sulfur boiler fuel oil to an all distillate synthetic crude oil. Ashland's primary interest is in the syncrude operation which not only produces crude oil substitutes but could produce significant amounts of petrochemical feedstocks. The process has converted a wide variety of coals including: bituminous, subbituminous, lignites, and brown coal. The process is not limited by either the rank of coal or by the nature of the ash contained in the coal. There is now under construction at Catlettsburg, Kentucky a large scale H-Coal pilot plant designed to process 200 to 600 tons per day of coal. Operation of this pilot plant will be the last step necessary to establish technical feasibility of the H-Coal process and provide data for design of a commercial plant. The H-Coal reactor is the key to the versatility of the process. The reactor is charged with catalyst supported on a grid and distribution plate near the bottom of the unit. Then, in operation, the catalyst bed is expanded by the upward flow of the reactants and an internal recycle stream; thus, the catalyst particles are kept in random motion. all of the reactor's products, including unreacted coal and ash, are taken overhead above the level of the expanded catalyst bed. External flash separators are used to separate the gases (both products and recycle hydrogen) from the solids containing liquids.

19960 (CONF-790749—, pp 92-112) **Exxon Donor Solvent process development: an interim report.** Zaczepinski, S. (Exxon Research and Engineering Co., Baytown, TX). Dec 1979.

From Conference on advanced materials for alternate fuel capable directly fired heat engines; Castine, ME, USA (30 Jul 1979).

This paper presents the development status of the Exxon Donor Solvent (EDS) coal liquefaction process. Specifically, it provides an overview of the project and a brief process description, a definition of the integrated R and D program underway, and a discussion of the process coal flexibility and the corresponding product flexibilities. Particular emphasis is placed on the properties and end-use performance of the mid-distillate stream. The EDS development program is proceeding very satisfactorily. The process has exhibited excellent feedstock flexibility and good operability. The expected EDS products dispositions have been defined and the corresponding end-use tests have been performed. In addition, process flexibility to alter the product slate and thus meet demand patterns has been defined. These elements, combined with extensive engineering studies and the planned operations of the large liquefaction pilot plant (250 T/D) and the FLEXICOKING Prototype Unit (70 T/D) represent the key milestones towards achieving the ultimate goal of commercial readiness in 1982.

19961 (DOE/ET/2625—9) **Economics and siting of Fischer-Tropsch coal liquefaction.** Henry, J.P. Jr.; Ferreira, J.P.; Benefiel, J.; Fassett, M. (Booz, Allen and Hamilton, Inc., Bethesda, MD (USA)). Jul 1979. Contract ET-78-C-01-2625-009. 90p. Dep. NTIS, PC A05/MF A01.

The capital intensity and low conversion efficiency of Fischer-Tropsch synthesis makes it noncompetitive with conventional petroleum in the midterm (e.g., 5 to 10 years) under normal economic conditions. However, if crude oil prices rise to higher levels (e.g., $25 to $30/bbl), coal liquefaction processes may prove to be economical. It appears that several other processes under development may become economically attractive before Fischer-Tropsch, although Fischer-Tropsch is the only proven commercially feasible venture at present. The above statement is subject, however, to the successful demonstration and commercialization of these alternative processes. Fischer-Tropsch, as a commercially proven process, may be called upon as a backup should petroleum shortages ensue, world oil prices continue to increase dramatically, and alternate coal liquefaction processes fail to fully develop.

19962 (DOE/ET/14876—2) **Catalysts for upgrading coal-derived liquids. Quarterly report, January 1-March 31, 1980.** Crynes, B.L. (Oklahoma State Univ., Stillwater (USA). School of Chemical Engineering). 15 Apr 1980. Contract AC01-79ET14876. 18p. Dep. NTIS, PC A02/MF A01.

Construction of the new trickle-bed reactor was completed and one experiment was conducted. The experimental run was made using a Paraho coal-derived liquid containing 0.40% sulfur and 0.95% nitrogen. The catalyst utilized was an American Cyanamide HDN-30, Ni-Mo-Al_2O_3. Run conditions were at 399C (750F), 1500 psig and space times up to two hours. Sample analyses are not yet available from this experiment. Two runs were completed in the Catalyst Life Test Unit (CLTU) utilizing a liquid containing 50% Synthoil and 50% Raw Anthracene oil. This fluid has a 0.54% sulfur and 1.21% nitrogen. Two Ni-MoAl_2O_3 catalysts were used - Shell-324, and H-Oil. Both experiments were terminated prematurely because of equipment malfunction. Sample analyses are not yet available from these two experiments.

19963 (DOE/FE—0003/79(1)) **Coal liquefaction. Quarterly report, January-March 1979.** (Department of Energy, Washington, DC (USA). Div. of Coal Conversion). Jan 1980. 63p. Dep. NTIS, PC A04/MF A01.

Progress in DOE-supported coal liquefaction pilot plant projects is reported: company, location, contract, funding, process description, history and progress in the current quarter. Related projects discussed are: coking and gasification of liquefaction plant residues, filtration of coal liquids and refining of coal liquids by hydrogenation. (LTN)

19964 (EPRI-AF—1298(Vol.1)) **Nature and origin of asphaltenes in processed coals. Final report.** Whitehurst, D.D.; Mitchell, T.O.; Farcasiu, M.; Dickert, J.J. Jr. (Mobil Research and Development Corp., Princeton, NJ (USA). Central Research Div.). Dec 1979. 102p. Dep. NTIS, PC A06/MF A01.

The development of improved liquefaction technology requires a thorough understanding of the chemistry and mechanisms involved in converting coals to liquid fuels. The primary objectives of EPRI Project 410-1 were to develop such fundamental understanding of the thermal solvent refining of coal. This report constitutes the final report of a four year study. It consists of three volumes. The first volume contains a critical review of the chemistry and basic limitations of today's developing liquefaction processes, an overall summary of the significance of the results of the four-year project to present-day processes, and a detailed review of the last 1 1/2 years of the project. The second volume contains the bulk of the experimental work in the last 1 1/2 years of the project as well as a literature review of specific topics. Volume III contains the pertinent Appendices. Throughout this report, emphasis is placed on the initial phases of coal liquefaction with special attention to the chemical functionality, structure and properties of the initial products of coal. This chemistry is related to the basic constraints imposed on commercial processes such as achievable reaction times, temperatures, pressures, and production and chemical constitution of recycle solvents which are required for coal conversion. In the critical review of limitations of present-day technology, we attempt to integrate the understanding of the chemistry developed and suggest possible means to improve these processes.

19965 (EPRI-AF—1298(Vol.3)) **Nature and origin of asphaltenes in processed coals. Final report.** Whitehurst, D.D.; Mitchell, T.O.; Farcasiu, M.; Dickert, J.J. Jr. (Mobil Research and Development Corp., Princeton, NJ (USA). Central Research Div.). Dec 1979. 127p. Dep. NTIS, PC A07/MF A01.

The development of improved liquefaction technology requires a thorough understanding of the chemistry and mechanisms involved in converting coals to liquid fuels. The primary objectives of EPRI Project 410-1 were to develop such fundamental understanding of the thermal solvent refining of coal. This report constitutes the final report of a four year study. It consists of three volumes. The first volume contains a critical review of the chemistry and basic limitations of today's developing liquefaction processes; an overall summary of the significance of the results of the four-year project to present-day processes; and a detailed review of the last 1 1/2 years of the project. The second volume contains the bulk of the experimental work in the last 1 1/2 years of the project as well as a literature review of specific topics. Volume III contains the pertinent Appendices. Throughout this report, emphasis is placed on the initial phases of coal liquefaction with special attention to the chemical functionality, structure and properties of the initial products of coal. This chemistry is related to the basic constraints imposed on commercial processes such as achievable reaction times, temperatures, pressures, and production and chemical constitution of recycle solvents which are required for coal conversion. In the critical review of limitations of present-day technology, we attempt to integrate the understanding of the chemistry developed and suggest possible means to improve these processes.

19966 (FE—2047/12) **Clean solid and liquid fuels from coal. Quarterly progress report, January-March 1979.** Gary, J.H.; Golden, J.O.; Bain, R.L. (Colorado School of Mines, Golden (USA). Dept. of Chemical and Petroleum Refining; Engineering). Jul 1979. Contract EX-76-C-01-2047. 42p. Dep. NTIS, PC A04/MF A01.

During the past quarter the continuous processing unit was operated using only the preheater in an attempt to define reactor inlet compositions (preasphaltenes, asphaltenes, and oils). Product yields obtained were comparable to those obtained using both the preheater and reactor. At the present time, yields can be modelled as a function of temperature (results are presented in this report) but not of residence time. During the next quarter, experiments will be performed at much shorter residence times (5 minutes) and much longer residence times (4 hours) to obtain data useful for kinetic modelling. A detailed design for a semi-continuous cold-head reactor system is also presented in this report.

19967 (FE—2315-40) **Refining and upgrading of synfuels from coal and oil shales by advanced catalytic processes. Quarterly report, April-June 1979.** Sullivan, R.F.; O'Rear, D.J. (Chevron Research Co., Richmond, CA (USA)). Jul 1979. Contract EX-76-C-01-2315. 79p. Dep. NTIS, PC A05/MF A01.

Pilot plant tests on the hydrotreating of SRC-II process product indicate that this coal-derived feed is suitable for refining using advanced commercial petroleum processing technology. Experiments were completed to evaluate several different combinations of refinery processes for conversion of SRC-II to transportation fuels. Nitrogen in the whole SRC-II process product can be reduced to a concentration of less than 0.5 ppM in a single catalytic stage. Sulfur and oxygen can also be reduced to low levels; and at high severity, most of the aromatic compounds are converted to napthenes. The naphtha appears to be an excellent catalytic reformer feed, and the middle distillate meets the smoke point and stability specifications for jet fuel. As the processing severity is decreased, product nitrogen increases; and the product becomes more aromatic. In the latter case, further hydrotreating of the naphtha is required before it can be fed to the second stage of a catalytic reformer. Depending on the severity employed, it may be necessary to further hydrogenate the jet boiling range product for specification jet fuel. Experiments were made to determine appropriate conditions for these processing steps. Alternate processing schemes include hydrocracking and catalytic cracking. In this report, pilot plant results for a two-stage hydrocracker are presented. Early pilot plant results indicate that H-Coal whole process product can be hydrotreated to make a jet fuel similar to the jet fuel from SRC-II whole process product. Since H-Coal whole process product contains 1.5 wt % more hydrogen than does SRC-II product, the H-Coal product requires 700 SCFB less hydrogen during hydrotreating. Unfortunately, the ash and asphaltene impurities in the H-Coal product we have processed have made the pilot plant operation difficult.

19968 (FE—2514-31) **Developmental research program for clean industrial and transportation fuels from coal. Final report, September 1976-March 1979.** Schindler, H.D.; Long, R.H. (Lummus Co., Bloomfield, NJ (USA)). Dec 1979. Contract EF-76-C-01-2514. 171p. Dep. NTIS, PC A08/MF A01.

An integrated coal liquefaction process development unit was operated to demonstrate The Lummus Clean Fuels From Coal (CFFC) Process. The objectives were as follows: Establishment of integrated operation, demonstration of solvent self-sufficiency on equilibrium solvent, life testing of catalyst, process variable studies, and comparative catalyst performance against a reference coal liquefaction catalyst. The extent of attainment of the objectives may be summarized as follows: Integrated operation was achieved, solvent self-sufficiency was demonstrated, catalyst life test data were obtained, process variable studies were completed, and comparative catalyst activity data were obtained. The major reactor feature of the CFFC process is an approach to plug flow of the coal paste through a series of expanded-bed reactors. This flow regime provides the best kinetics for heteroatom removal, emphasizes distillate (400 to 850°F) production and thereby minimizes hydrogen consumption at nearly complete coal conversion. This was amply demonstrated during the process variable study, where the maximum chemical hydrogen consumption was 3.7 weight percent for the most reaction conditions. For the less severe conditions appropriate for this process, chemical hydrogen consumption was approximately 3 wt%. The catalyst life study showed that a +400°F boiler fuel product containing 0.3% sulfur, 0.5% nitrogen and 0.1% ash is made with a catalyst consumption of 1.21 pounds per ton of coal. The hydrogen consumption of about 3 percent required to make this clean liquid product is lower than for any other one or two-stage coal liquefaction process. A part of the process variable study, high-viscosity runs, utilizing minimum recycle, established the upper through-put limit in the first reactor to be 3.6 to 3.9 lb coal/hr/lb catalyst, depending on the catalyst shape.

19969 (FE—2595-3) **Development of new catalysts for coal liquids refining. Third quarterly report, July 1, 1979-September 30, 1979.** Schwager, I. (Filtrol Corp., Los Angeles, CA (USA)). Oct 1979. Contract ET-78-C-01-2595. 27p. Dep. NTIS, PC A03/MF A01.

Base-line catalyst testing conditions for hydrotreating SRC-II Fuel Oil Blend have been determined: temperature, 750°F; pressure, 1,000 psig; LHSV, 1 ml/ml-hr; and H_2 flow rate, 5000 SCF/bbl. At these conditions the average values for HDN and HDS with the commercial Filtrol catalyst HPC-40 (Ni-Mo on γ-alumina) are 88 +- 2 and 89 +- 2%, respectively. With Filtrol HP-6 (Co-Mo on γ-alumina) the HDN and HDS values are 78 and 92%, respectively. Hydrotreating catalyst testing on a series of exploratory catalysts, with different metals loadings and support properties, has been initiated. Ni-Mo catalysts appear to be more active for HDN, whereas, Co-Mo catalysts appear to be more active for HDS. Both Ni-W and Co-W catalysts appear to be less active than their Ni- and Co-Mo counterparts. Synthesis and characterization of various catalytic components is being carried out. Cation exchange of the materials is proceeding. Pilot Plant batches of silica-alumina, silica-alumina-magnesia, and silica-alumina-zirconia gels have been prepared. Exploratory cracking, hydrocracking, and hydrotreating catalysts are being produced in preparation for activity testing.

19970 (FE—3297-1, pp 1-79) **Process and catalyst needs for hydrodenitrogenation.** Katzer, J.R.; Sivasubramanian, R. (Univ. of Delaware, Newark). 1 Mar 1979.

In Development of unique catalysts for hydrodenitrogenation of coal-derived liquids. First quarterly report, September 15-December 15, 1978.

Current hydrodenitrogenation catalysts and processes are essentially an extension of the catalysts and processes used in the petroleum industry for hydrodesulfurization. Limitations exist in the application of the existing catalyst technology to hydrodenitrogenation of synthetic fuels and heavy petroleum feedstocks. This article reviews the existing chemistry and technology for hydrodenitrogenation and projects catalyst and process needs for hydrodenitrogenation of synthetic feedstocks and heavy petroleum liquids. It projects what should be a more effective means and a more rational basis for the design and development of more active and more selective catalysts for hydrodenitrogenation and attempts some speculations on potentially fruitful directions to be followed in both catalyst and process development.

19971 (ISM—246) **Materials for coal liquefaction.** Scott, T.E. (Ames Lab., IA (USA)). Oct 1979. Contract W-7405-ENG-82. 71p. (CONF-791014—1). Dep. NTIS, PC A04/MF A01.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

An attempt is made to summarize the failures already experienced, most of which are highly visible such as erosion or corrosion; indicate problems which are not failures but bear on cost effectiveness; point out potential problems which might effect reliability and safety; cite the efforts being made to solve these problems; and suggest some future directions for consideration. It is important to recognize that solutions to problems uncovered in pilot plant scale operations may not suffice in commercial scale plants. On the other hand, some pilot plant problems may be eliminated or mitigated in large components for commercial plants. How the interaction between liquefaction process factors and materials will scale is largely unknown because, in most instances, fundamental understanding of the interactions are not understood.

19972 (LBL—10498) **Catalytic liquefaction by zinc chloride melts at pre-pyrolysis temperature.** Vermeulen, T.; Onu, C.; Joyce, P.J.; Hershkowitz, F.; Grens, E.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Feb 1980. Contract W-7405-ENG-48. 8p. (CONF-800610—3). Dep. NTIS, PC A02/MF A01.

From American Institute of Chemical Engineering conference; Philadelphia, PA, USA (8 Jun 1980).

Liquid-phase catalysts have proved effective for opening chemical linkages in subbituminous coal and capping the reactive segments with hydrogen atoms or other low-molecular-weight groups. The preferred temperature range is 275 to 325°C (530 to 620°F), so that the linkages are opened by controlled catalytic action rather than by thermal pyrolysis which requires appreciably higher temperatures. The best catalyst melt compositions used to date are zinc chloride with 10% water together with tetralin, and zinc chloride with 15% methanol and 3% of zinc metal. Useful residence times range from 30 minutes, or less, to as high as 90 minutes. The products of the treatment have predominately low (300) to medium (3000) molecular weights, analogous to syncrudes and solvent-refined coal. Conversions to pyridine-soluble products of 95% or better are achieved with Wyodak Roland Seam coal, and to date as much as 70% of that coal has been recovered as toluene-solubles (oils and asphaltenes). A major benefit of these conversion conditions is the almost complete absence of by-product char or gas. At these lower temperatures the hydrogen pressures used can be less than in conventional liquefaction; for example, 40 atm rather than 100 atm or more. Hydrogen consumption is significantly lower than in conventional liquefaction; the product yield is higher; and simpler procedures are foreseen for product recovery. The research performed so far clearly shows the industrial potential of homogeneous (liquid-phase) catalysts in penetrating and interacting with the mild temperature and pressure of these studies.

19973 (SAND—80-0031C) **Catalyst residence time distribution in the H-coal coal liquefaction PDU.** Bickel, T.C.; Thomas, M.G. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 21p. (CONF-800610—4). Dep. NTIS, PC A02/MF A01.

From American Institute of Chemical Engineering conference; Philadelphia, PA, USA (8 Jun 1980).

The internal age distribution of catalyst in Hydrocarbon Research, Incorporated H-Coal 28-day Process Demonstration Unit (PDU) Run No. 9 has been determined using Co^{60}-tagged American Cyanamid HDS 1442A CoMo catalyst. A 3.5 pound charge of tagged catalyst, approximately 397 μCi total activity, was added at day three of steady state operation. Standard incidence counting methods were employed to determine the external age distribution of catalyst from the reactor based upon the concentration of tagged catalyst in subsequent daily withdrawals and final dump of the reactor. Approximately 43 percent of the tagged catalyst remained in the reactor at the conclusion of the PDU run. The dimensionless Peclet number was determined to be 0.451 based upon an axial flow dispersion model. The internal age distribution of catalyst in the reactor was determined as a function of reactor operating time; the mean residence time of the catalyst in the reactor approached within ten percent of its steady state value after approximately 90 days of simulated reactor operation.

19974 **Evaluation of use of syngas for coal liquefaction.** Batchelder, R.F.; Fu, Y.C. (US DOE, Pittsburgh, Pa). *Ind. Eng. Chem., Process Des. Dev.;* **18**: No. 4, 594-599(Oct 1979).

Coal liquefaction processes by direct catalytic liquefaction or extractive hydrogenation could benefit economically by using syngas in place of hydrogen. Data are presented to show that the hydrotreating of bituminous coal using syngas and steam with $CoMo-K_2CO_3$ catalyst gave product oil similar to that obtained from the hydrotreating using H_2 and Co-Mo catalyst. A comparative process evaluation has been made for the direct catalytic liquefaction of coal using H_2 and syngas. Summaries of mass balance, energy balance, and cost estimation are presented. The use of syngas reduces the capital and operating costs by eliminating shift convertors and gas purifying systems and thus could reduce the process cost of SYNTHOIL and H-coal by about 14%. The process economics could be further improved by the use of a high-pressure coal gasification process for the syngas production.

19975 **Charge and filtration of solvent refined coal suspensions.** Steininger, R.J. II; Radke, C.J.; Hanson, D.N. (Univ of Calif, Berkeley). *Ind. Eng. Chem., Process Des. Dev.;* **18**: No. 4, 708-713(Oct 1979).

The surface properties of ash from Solvent Refined Coal filter feed are studied to investigate their effect on ash filtration. Quantita-

tive measurements of the surface charge of ash particles in organic liquids are obtained from microelectrophoresis. Ash exhibits a positive $zeta$ potential of approximately 50 mV in pyridine and in natural coal solvent. No charge is observed for pyridine-extracted ash particles immersed in nonpolar organic liquids. Charge arises only in solvents which dissolve and permit some ionization of asphaltene components. The influence of ash suspension stability on filtration is determined by correlating $zeta$ potentials with specific cake resistances. Reduction of the ash surface charge in pyridine to values near zero with copper oleate yields a tenfold increase in filtration rate.

19976 SRC corrosion can be solved!. Canfield, D.R.; Ibarra, S.; McCoy, J.D. (Pittsburg and Midway Coal Min Co, Ft. Lewis, Wash). *Hydrocarbon Process.;* **58**: No. 7, 203-208(Jul 1979).

This paper is concerned with several corrosion/erosion problems which occurred in four major processing areas of the Solvent Refined Coal Process pilot plant at Ft. Lewis, Wash. These process areas are generally referred to as follows: coal receiving and preparation, preheating and dissolving, filtration and mineral residue drying, and solvent recovery. Extensive experimental data are included. It is concluded that solutions to the corrosion problems encountered on SRC plants have been found to be satisfactory.

19977 Process for preparing alumina. Sanchez, M.G.; Laine, N.R. (to W.R. Grace & Co.). US Patent 4,154,812. 15 May 1979. Filed date 25 Mar 1977. vp.

An alumina composition comprising a microcrystalline boehmite-pseudoboehmite intermediate having from about 70 to about 85 weight percent of the total amount of Al_2O_3 present in crystalline form. The composition is prepared by adding aluminum sulfate and sodium aluminate solutions to a mixture of water and aluminum sulfate solution to precipitate alumina and adjusting the pH to a pH higher than the precipitation pH. The reactant concentrations, and rates of addition, temperatures, and pH's in the precipitation are specifically controlled to form the boehmite-pseudoboehmite intermediate.

PYROLYSIS AND CRACKING

REFER ALSO TO CITATION(S) 20024

19978 (CONF-800303—14) **Thermolysis of partial coal structures: bibenzyl and naphthols.** Poutsma, M.L. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 14p. Dep. NTIS, PC A02/MF A01.

From 179. national meeting of the American Chemical Society; Houston, TX, USA (23 Mar 1980).

All proposed processes for direct conversion of coal to synthetic liquid fuels require heating to ≧ 400°C. Exact process conditions (pyrolysis, hydropyrolysis, catalytic hydrogenation, donor solvent refining) are vital in determining the final product state (1). However, underlying all these processes may well be a set of similar thermal reactions which lead to disruption of the organic macromolecular structure of coal. Because of the structural complexity and irregularity of coal, attempts to elucidate this thermal chemistry of coal and of donor process solvents have relied heavily on thermolysis studies of model organic structures (2) and the judicious use of structure-reactivity relationships which are central to the discipline of physical organic chemistry. In this work the reaction products of the pyrolysis of bibenzyl and naphthals were identified.

BY-PRODUCTS

REFER ALSO TO CITATION(S) 20249

19979 Development of coalbed methane as an energy source. Olson, M.L. (DOE, Washington, DC). *Energy Sources (N.Y.);* **4**: No. 4, 353-365(1979).

Coalbed methane is the unconventional gas source that could perhaps be put into production most quickly and cheaply. In order to promote the development of this potentially large resource, government agencies can do three significant things: initiate a coring program for resource definition; cooperate in clarifying the status of the resource and in prescribing the rights of all interested parties; and establish incentive programs to speed production and use of the resource. A number of legal and institutional concerns relate to the development of coalbed methane. These concerns include ownership rights, the meaning of the word gas in regulatory language, the form of regulating this resource that is interrelated with the coal resource; and the conservation of resources. Although production from each well is low, the increased need for domestic energy supplies and the economics of production are coming together to make the development of this resource of some interest.

PROPERTIES

REFER ALSO TO CITATION(S) 19913, 19915, 19918, 19922, 19940, 19948, 19953, 19957, 20944

19980 (DOE/NASA/2593—79/8) **Literature survey of properties of synfuels derived from coal.** Reynolds, T.W.; Niedzwiecki, R.W.; Clark, J.S. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Feb 1980. Contract EF-77-A-01-2593. 164p. (NASA-TM—79243). Dep. NTIS, PC A08/MF A01.

This report contains the results of a literature survey conducted by the NASA Lewis Research Center. The survey objective was to systematically assemble existing data on the physical, chemical, and elemental composition and structural characteristics of synthetic fuels (liquids and gas) derived from coal. Contained herein are the results compiled to December 1977: (1) A general description of fuel properties, with emphasis on those properties required for synfuels to be used in gas-turbine systems for industry and utilities. (2) Descriptions of the four major concepts for converting coal into liquid fuels (i.e, solvent extraction, catalytic liquefaction, pyrolysis, and indirect liquefaction); (3) Data obtained from the literature on full-range syncrudes, various distillate cuts, and upgrade products for fuels derived by various processes - including H-Coal, Synthoil, Solvent-Refined Coal, COED, Donor Solvent, Zinc Chloride Hydrocracking, Co-Steam, and Flash Pyrolysis (The data are segregated into tables according to the processes by which they were derived, and they are also tabulated by fuel type so that fuels of similar cut can be compared for the various processes); (4) Data plots illustrating trends in the properties of fuels derived by several processes; (5) A source list and bibliography on syncrude production and upgrading programs; (6) A listing of some Federal energy contracts for coal-derived synthetic fuels production and upgrading programs. Since information on synfuels is not readily available in the literature, additional information sources were used in compiling the survey, such as monthly contractor reports from ongoing Department of Energy projects and private correspondence. These sources are noted in the data tables where applicable.

19981 (FE—2030-16) **Characteristics of American coals in relation to their conversion into clean energy fuels. Quarterly technical progress report, April-June 1979.** Spackman, W.; Davis, A.; Walker, P.L.; Lovell, H.L.; Vastola, F.J.; Given, P.H.; Suhr, N.H.; Jenkins, R.G. (Pennsylvania State Univ., University Park (USA). Coal Research Section). Jan 1980. Contract EX-76-C-01-2030. 59p. Dep. NTIS, PC A04/MF A01.

The study is continuing into the effects of low temperature oxidation on reducing the agglomerating properties of caking coals. Increases in oxidation temperature are shown to increase the effectiveness of oxygen in destroying plastic properties. Controlled studies indicate that additions of small amounts of oxygen (1 to 2% by wt) bring about drastic reductions in swelling properties. Oxidation may be considered a surface pheneomenon and it is shown here that the plastic properties of oxodized coals are partially restored by grinding to expose new surface. Finally, water vapor is shown to have an enhancing effect on room-temperature oxidation of coal. In the same task, small angle x-ray scattering (SAXS) techniques are beng evaluated as a method for determining size distributions of heterogeneities in coal chars. To test the applicability of the procedures, SAXS data have been generated from a well characterized glassy carbon (Tokai GC-30) and Saran chars prepared at different heat treatment temperatures (1100, 1300, 1500°C). Results indicate that these approaches hold much promise for characterizing the porous structure of microporous carbons. Experimental conditions for Saran char burn-off have been chosen. Burn-off plots for two different particle sizes using the gas chromatograph tube furnace system have been constructed. The determination of the carboxyl group content of the three American lignites chosen has been completed. The results are included in this report. Also, the exchanged coal was back-exchanged with perchloric acid. The barium released was analyzed by emission spectrometry and compared to the value found by the original barium acetate treatment. The results show good agreement. Work was also undertaken to analyze the carboxylic salts.

19982 (FE—2710-9) **Development of instrumental methods of analysis of sulfur compounds in coal process streams. Ninth quarterly technical progress report, October-December 1979.** Jordan, J. (Pennsylvania State Univ., University Park (USA). Dept. of Chemistry). Jan 1980. Contract EF-77-S-01-2710. 26p. Dep. NTIS, PC A03/MF A01.

Capabilities for constructing multidimensional Pourbaix Diagrams have been expanded. New algorithms have been developed for the generation of abundance profiles and for delineating thermodynamic stability domains of poly-sulfur moieties, which contain several atoms of sulfur per molecule. Mechanisms of electrooxidation of thiosulfate and of dibenzothiophene have been investigated.

Under judiciously controlled experimental conditions, these electrode reactions proceed with 100% current efficiency at glassy carbon anodes. They provide a sound theoretical basis for dependable electroanalytical methods applicable to the determination of $S_2O_3^-$ and of dibenzothiophene in coal conversion process streams and products. The systematic search for specific reagents, amenable to the determination of sulfur contaminants by thermometric enthalpy titration and by direct injection enthalpimetry, was continued. 0.12% sulfide has been successfully determined by differential pulse polarography at a dropping mercury anode in scrubber water from a coal liquefaction process. Concentration levels of 1 ppM (or less) of sulfide were estimated in two gasifier condensate samples by the same method. Differential pulse voltammetry at a rotated glassy carbon disk anode was used to detect and determine quantitatively the presence of 0.1% dibenzothiophene in an SRC II stripper bottom product.

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 20241, 20576, 20577, 20578, 20579, 20584, 20825

19983 (ANL/CEN/FE—79-18) **Diatomaceous earth and activated bauxite used as granular sorbents for the removal of sodium chloride vapor from hot flue gas.** Lee, S.H.D.; Swift, W.M.; Johnson, I. (Argonne National Lab., IL (USA)). Jan 1980. Contract W-31-109-ENG-38. 39p. Dep. NTIS, PC A03/MF A01.

Diatomaceous earth and activated bauxite were tested as granular sorbents for use as filter media in granular-bed filters for the removal of gaseous alkali metal compounds from the hot (800°C) flue gas of PFBC. Tests were performed at atmospheric pressure, using NaCl vapor transported in relatively dry simulated flue gas of PFBC. Either a fixed-bed combustor or a high-temperature sorption test rig was used. The effects of sorbent bed temperature, superficial gas velocity, gas hourly space velocity, and NaCl-vapor concentration in flue gas on the sorption behavior of these two sorbents and their ultimate sorption capacities were determined. Both diatomaceous earth and activated bauxite were found to be very effective in removing NaCl vapor from flue gas. Preliminary cost evaluations showed that they are economically attractive as granular sorbents for cleaning alkali vapor from simulated flue gas.

19984 (ANL/PAG—1) **Biological removal of organic constituents in quench water from a slagging, fixed-bed coal-gasification pilot plant.** Stamoudis, V.C.; Luthy, R.G. (Argonne National Lab., IL (USA)). Feb 1980. Contract W-31-109-ENG-38. 26p. Dep. NTIS, PC A03/MF A01.

This study is part of an effort to assess the efficiency of activated-sludge treatment for removal of organic constituents from high-Btu coal-gasification pilot-plant quench waters. A sample of raw-gas quench water was obtained from the Grand Forks Energy and Technology Center's pilot plant, which employs the slagging, fixed-bed gasification process. The quench water generated in the processing of Indian Head lignite was pretreated to reduce ammonia and alkalinity, and then diluted and subjected to long-term biological treatment, followed by detailed characterization and analysis of organic constituents. The pretreated (influent) and treated (effluent) samples were extracted using a methylene chloride, pH-fractionation method to obtain acid, base, and neutral fractions, which were analyzed by capillary-column gas chromatography/mass spectrometry (GC/MS). Over 99% of the total extractable and chromatographable organic material in the influent acid fraction was composed of phenol and alkylated phenols. Biological treatment removed these compounds almost completely. Major components of the influent base fraction were alkylated pyridines, anilines, aminopyrroles, imidazoles and/or pyrazoles, diazines, and quinolines. Removal efficiency of these compounds ranged between 90 and 100%. The influent neutral fraction was composed mainly of cycloalkanes, cycloalkenes, naphthalene, indole, acetophenone, and benzonitrile. Alkylated benzenes were generally absent. Removal efficiencies of these compounds were generally very good, except for certain alkylated cycloalkanes and cycloalkenes. Results are compared with those of a similar study on HYGAS coal-gasification quench water.

19985 (ANL/PAG—2) **Biological removal of organic constituents in quench waters from high-Btu coal-gasification pilot plants.** Stamoudis, V.C.; Luthy, R.G. (Argonne National Lab., IL (USA)). Feb 1980. Contract W-31-109-ENG-38. 29p. Dep. NTIS, PC A03/MF A01.

Studies were initiated to assess the efficiency of bench-scale, activated-sludge treatment for removal of organic constituents from coal-gasification process effluents. Samples of pilot-plant, raw-gas quench waters were obtained from the HYGAS process of the Institute of Gas Technology and from the slagging, fixed-bed (SFB) process of the Grand Forks Energy Technology Center. The types of coal employed were Bituminous Illinois No. 6 for the HYGAS and Indian Head lignite for the SFB process. These pilot-plant quench waters, while not strictly representative of commercial condensates, were considered useful to evaluate the efficiency of biological oxidation for the removal of organics. Biological-reactor influent and effluent samples were extracted using a methylene chloride pH-fractionation method into acid, base, and neutral fractions, which were analyzed by capillary-column gas-chromatography/mass-spectrometry. Influent acid fractions of both HYGAS and SFB condensates showed that nearly 99% of extractable and chromatographable organic material comprised phenol and alkylated phenols. Activated-sludge treatment removed these compounds almost completely. Removal efficiency of base-fraction organics was generally good, except for certain alkylated pyridines. Removal of neutral-fraction organics was also good, except for certain alkylated benzenes, certain polycyclic aromatic hydrocarbons, and certain cycloalkanes and cycloalkenes, especially at low influent concentrations.

19986 (CONF-791108—22(Draft)) **Potential costs of environmental control processes for low-btu coal gasification plants.** Singh, S.P.N.; Fisher, J.F.; Peterson, G.R. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 27p. Dep. NTIS, PC A03/MF A01.

From 72. AICHE meeting; San Francisco, CA, USA (25 Nov 1979).

The potential costs for environmental control processes were developed for eight conceptual low-Btu coal gasification plants to illustrate the impact of alternate pollution abatement technologies in producing environmentally clean low-Btu gas from coal. Due to time and funding limitations, the evaluations were restricted to alternate particulate recovery, sour gas and wastewater treating processes; no water solids disposal processes (other than landfill operations) were considered. The eight cases were selected from a matrix comprising of four different US coal types, gasifiers, nominal plant capacities, and potential plant locations. The environmental control schemes for the plants were developed to meet current (1978) EPA guidelines for effluent discharge from coal processing facilities. Economic evaluations were performed using first-quarter 1978 costs for four different economic scenarios (100% and 70/30 debt/equity capitalization, 12 and 15% annual after-tax rate of return on equity, and 9% interest on debt). The probable accuracy of the economic evaluations is estimated to be ~ +-30 percent. One of the conclusions from the study is that the price of the cleaned low-Btu gas can vary from $3.46/GJ ($3.65/MMBtu) for gas from 9070 metric ton/day [t/d](10,000 ton/day) Lurgi dry-ash gasifier to $7.39/GJ ($7.80/MMBtu) for gas from a 180 t/d (200 ton/day) Wellman-Galusha gasifier. Other conclusions are presented in the text. While the results presented should not be regarded as being absolute or definitive in nature, they do illustrate the potential impact of pollution control processes on the product price of environmentally clean low-Btu coal gas.

19987 (CONF-800309—4) **Collection, disposal, and storage of carbon dioxide.** Baes, C.F. Jr.; Beall, S.E.; Lee, D.W.; Marland, G. (Oak Ridge Associated Universities, Inc., TN (USA); Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 27p. Dep. NTIS, PC A03/MF A01.

From International workshop on the energy/climate interactions; Munster, F.R. Germany (3 Mar 1980).

To scrub CO_2 from the stack gas of a coal fired plant by the most efficient means presently available will require about 43% of the combustion energy of the coal. While appreciable improvement might be realized by burning the coal in pure oxygen, any method of recovery from stack gas will use a substantial fraction of the energy content of the fuel. The best option for disposal is in the ocean, in the form of a negatively-buoyant plume of concentrated solution that would carry the CO_2 to deep water and give retention times of many hundreds of years. Alternatively, liquid CO_2 could be injected at great depth, or blocks of the solid hydrate or dry ice might be released at the ocean surface. The most efficient option for the future might be floating power stations that use cold, deep seawater both for condenser cooling and CO_2 disposal. Depleted oil and gas fields could be used as a near-term storage option. Storage as buried biomass or as a solid near the South Pole seems the least attractive of the options considered.

19988 (CONF-7904130—1) **Experimental studies on the land disposal of coal gasification residues.** Boegly, W.J. Jr.; Wilson, H.W. Jr.; Francis, C.W.; Davis, E.C. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 11p. Dep. NTIS, PC A11/MF A01.

From Solid waste research and development needs for emerging coal technologies workshop; San Diego, CA, USA (22 Apr 1979).

Solid wastes produced in all stages of the coal fuel cycle (mining, processing, beneficiation, and utilization) may represent a major fraction of the total solid waste produced in the United States each year. Passage of the 1976 Resource Conservation and Recovery Act (RCRA) can produce significant impacts on generators of large

volumes of solid waste. One of the key features of RCRA is the designation of wastes as being hazardous or nonhazardous depending on the results obtained by a standardized leaching test now under development. Hazardous solid wastes must be disposed of in landfills that ensure that no contamination results from leachates entering potential or existing water supplies. These landfills are likely to cost an order of magnitude more than landfills for nonhazardous wastes. The objective of the Stored Solids Study at the Oak Ridge National (ORNL) is to provide design critria that comply with the RCRA for geological disposal of solid wastes at coal gasification demonstration facilities. The major emphasis is directed at alerting the specific emerging coal technology of possible environmental impacts of ground-water leachate from coal conversion residues in land disposal sites, as well as in runoff from rainfall on coal storage piles. The studies represent an engineering-oriented approach to attenuate the dissolution and subsequent movement of coal conversion solid wastes by using suitable geologic media and a knowledge of the geochemical interactions between the leachate and local soils. First-order dissolution rates have been determined for components of some of the wastes. The experimental program utilizes a three-step approach: charactrization, evaluation, and prediction.

19989 (CONF-7910108—3(Draft)) **Open-pore polyurethane as a medium for coal conversion process aqueous effluent cleanup.** Denton, M.S.; Dinsmore, S.R.; Brand, J.I.; Beams, J.; Ball, F.L. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 29p. Dep. NTIS, PC A03/MF A01.

From Symposium on separation science and technology for energy applications; Gatlinburg, TN, USA (30 Oct 1979).

A study was made of varying the reaction conditions of in-situ polymerized open-pore polyurethane (OPP). Optimum conditions were determined by electron microscopy and flow rate studies. Using these conditions, large 1-in x 12-in columns were polymerized and compared, by use of a four column bench-scale adsorption apparatus, with the same type columns filled with three common commercial adsorbents. Breakthrough curves (TOC, total phenol, etc.) of a synthetic and an actual coal conversion wastewater were then plotted for each of these columns. In summary, in-situ foamed open-pore polyurethane offers a very promising alternative to commonly used resins and charcoals for waste-water cleanup. Comparative cost and elution characteristics (it can even be completely dissolved in certain acids for total recoveries) are among its advantages. The primary disadvantage of OPP is that it will, after very large volumes of water, finally break away from the glass walls. This problem is being investigated.

19990 (UCRL—15223) **Activated carbon adsorption of ground water contaminants from in-situ coal gasification.** Thompson, R.E. (National Technical Services, Inc., Corvallis, OR (USA)). 1980. Contract W-7405-ENG-48. 32p. Dep. NTIS, PC A03/MF A01.

Previous work has demonstrated the feasibility of adsorbing organic chemicals from aqueous solutions using activated carbon as the adsorbent. These tests were carried out to evaluate the adsorbability of mixed organic contaminants found in ground waters adjacent to in-situ coal gasification sites. Information generated from these tests will be used to determine the feasibility of testing the regeneration or disposal of spent powdered activated carbon and to design an above ground activated carbon treatment system.

19991 **Effects of sodium chloride on limestone calcination and sulfation in fluidized-bed combustion.** Shearer, J.A.; Johnson, I.; Turner, C.B. (Argonne Natl Lab, Ill). *Environ. Sci. Technol.;* **13**: No. 9, 1113-1118(Sep 1979).

A laboratory investigation of the interaction of sodium chloride with natural limestones during calcination and sulfation has been performed. Reactions were carried out at 850°C in a synthetic flue gas consisting of 0.3% SO_2, 5%0_2, 20% CO_2, and the balance nitrogen. Application of NaCl addition to fluidized-bed coal combustion increased the sulfur capacity of unreactive limestone and reduced the quantity of limestone needed and the amount of solid waste produced in meeting SO_2 emission standards.

19992 **Characterization of organics in aqueous effluents of coal-conversion processes.** Pitt, W.W. Jr.; Jolley, R.L.; Jones, G. (Oak Ridge National Lab., TN). *Environ. Int.;* **2**: No. 3, 167-171(1979).

High-resolution liquid chromatography is being applied to the characterization of refractory organic compounds present in coal-conversion streams at concentrations as low as a few micrograms per liter. The chromatographic system, which was previously developed for the analysis of the molecular biochemical constituents in human body fluids, is capable of analyzing for compounds that are ultraviolet absorbing and/or oxidizable with sulfatoceric acid. Aqueous samples from various coal-liquefaction experiments were collected, concentrated when necessary, and chromatographed. The chromatographic fractions were then subjected to a multiple-analytical indentification procedure utilizing, in sequence, uv spectrometry, gas chromatography, and mass spectrometry. With this procedure, 18 organics were identified and 15 were quantified in the effluent from the product scrubber of a bench-scale hydrocarbonization unit. Numerous unknown constituents have been characterized with respect to gas chromatographic and mass spectrometric properties. 4 references, 4 figures, 1 table.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 19907, 19915, 19986, 20012, 20044, 21159, 21189, 21190, 21191, 21203, 21211, 21235, 21236, 21238

19993 (ANL/ES—73) **Suitability of dredged material for reclamation of surface-mined land. Final report.** Harrison, W.; Van Luik, A. (Argonne National Lab., IL (USA)). Dec 1979. Contract W-31-109-ENG-38. 138p. Dep. NTIS, PC A07/MF A01.

Eroding ridges of acidic coal-mine spoil in La Salle County, Illinois, were leveled to form a gently-sloped raised plateau. Four test plots were constructed: a control plot and three treatment plots that received a 0.9-m-thick cover of dredged material obtained from the Metropolitan Sanitary District of Greater Chicago. Two treatment plots received lime applications and all plots were seeded with a mixture of grasses. Pressure-vacuum soil water samplers were installed, in duplicate, at two levels in the control plot and at three levels in each treatment plot. The three levels in the treatment plots coincided with dredged material, the dredged-material mine-spoil interface, and the underlying mine spoil. Surface water, soil water, and groundwater were monitored for 29 water-quality parameters for one year. Rainfall, air temperature, runoff, and water-level elevation data were collected also. Detailed analysis of the data indicates that the dredged material used in this study does not adversely affect water quality; it supports abundant plant growth, lessens groundwater contamination, and controls acid runoff. The dredged material is judged to be a suitable material for use in reclamation of surface-mined land.

19994 (ANL/LRP—6) **Comparison of lime and fly ash as amendments to acidic coal mine refusej growth responses and trace-element uptake of two grasses.** Jasrow, J.D.; Zimmerman, C.A.; Dvorak, A.J.; Hinchman, R.R. (Argonne National Lab., IL (USA)). Oct 1979. Contract W-31-109-ENG-38. 43p. Dep. NTIS, PC A03/MF A01.

Two commonly used revegetation species, Kentucky 31 tall fescue (Festuca arundinacea Schreb.) and Lincoln smooth brome (Bromus inermis Leyss.) were grown for 60 days in pots containing coarse coal mine refuse (referred to as gob, pH = 3.5) that was amended with lime or alkaline fly ash. Both species were also grown in pots containing a silt-loam surface soil as a control. Morphological growth parameters were measured over time; dry weights and shoot:root ratios were determined at harvest. Concentrations of Al, As, Cd, Co, Cr, Cu, Fe, Hg, Mn, Ni, Pb, Se, V, and Zn in the plant shoots were determined by atomic absorption spectrophotometry. Plant growth of both species was not as good on either lime- or fly ash-amended gob as it was on surface soil. Although plant height and length of the longest lead were not significantly different ($p > 0.10$) at the end of the experiment for plants grown on the two amended-gob substrates, parameters giving an indication of plant vigor (i.e., number of leaves and stems, width of the longest lead, and biomass) were significantly greater ($p < 0.01$) for plants grown on lime-amended gob than for those grown on fly ash-amended gob. Significant ($p < 0.05$) differences in the tissue concentrations of Cd, Co, Fe, Hg, Mn, Pb, V, and Zn were found among the plants grown on the three substrates. Except for Hg and Pb, these elements were higher in plants grown on at least one of the amended-gob substrates than in plants grown on surface soil. Significant substrate differences were not observed for Al, As, Cr, Cu, Ni, and Se. The tissue concentrations of some elements - notably Al, Cu, Fe, Mn, V, and Zn - were high enough in plants from one or more of the substrates to either approach or exceed concentrations that have been reported to be associated with toxic effects in some plant species.

19995 (CONF-800349—1) **Response of benthic insect species to changes in stream velocity resulting from stripmining disturbance.** Stair, D.M. Jr.; Tolbert, V.R. (Oak Ridge National Lab., TN (USA); Science Applications, Inc., Oak Ridge, TN (USA)). 1980. Contract W-7405-ENG-26. 3p. Dep. NTIS, PC A02/MF A01.

From Annual meeting of the North American Benthological Society; Savannah, GA, USA (Mar 1980).

Increased stream velocity resulting from increased runoff may cause considerable alterations in benthic communities. Stream velocity in disturbed watersheds can exceed tolerance limits of even the most resistant species. Increased velocities may also adversely impact benthic communities by increasing bedload movement, thus destroying habitats or physically abrading individuals. Studies are underway to document bedload movement and effects on benthic communities in mining disturbed streams. Additional studies are being initiated to determine if there are additive effects from the combination of increased stream velocity and sediment movement.

19996 (DOE/EV—0074) **Environmental data energy technology characterizations: coal.** (Department of Energy, Washington, DC (USA). Office of Technology Impacts). Apr 1980. 172p. Dep. NTIS, PC A08/MF A01.

This document describes the activities leading to the conversion of coal to electricity. Specifically, the activities consist of coal mining and beneficiation, coal transport, electric power generation, and power transmission. To enhance the usefulness of the material presented, resource requirements, energy products, and residuals for each activity area are normalized in terms of 10^{12} Btus of energy produced. Thus, the total effect of producing electricity from coal can be determined by combining the residuals associated with the appropriate activity areas. Emissions from the coal cycle are highly dependent upon the type of coal consumed as well as the control technology assigned to the activity area. Each area is assumed to be equipped with currently available control technologies that meet environmental regulations. The conventional boiler, for example, has an electrostatic precipitator and a flue gas desulfurization scrubber. While this results in the removal of most of the particulate matter and sulfur dioxide in the flue gas stream, it creates other new environmental residuals -- solid waste, sludge, and ash. There are many different types of mined coal. For informational purposes, two types from two major producing regions, the East and the West, are characterized here. The eastern coal is typical of the Northern Appalachian coal district with a high sulfur and heat content. The western coal, from the Powder River Basin, has much less sulfur, but also has a substantially lower heating value.

19997 (EPA—600/2-79-114a) **Particulate sampling and support. Final report, executive summary.** Cushing, K.M. (Southern Research Inst., Birmingham, AL (USA)). Nov 1979. 50p. NTIS.

The report summarizes results of research, development, and support tasks performed during the 3-year period of the contract (11/75-11/78). The tasks encompassed many aspects of particulate sampling and measurement in industrial gaseous process and effluent streams. Under this contract: cascade impactors were calibrated and evaluated; novel particle sampling cyclones were designed and evaluated; technical and procedures manuals were prepared for control device evaluation and particle sampling methods; an electrostatic precipitator backup was designed for high flow rate systems; and advanced concepts in monitoring particle mass and size, using optical systems, were evaluated. A detailed examination of the results of this contract is contained in the basic report, EPA-600/2-79-114.

19998 (ORO—3798-59) **Biophysical studies related to energy generation. Renewal proposal and progress report.** Green, A.E.S. (Florida Univ., Gainesville (USA). Dept. of Nuclear Engineering Sciences). Mar 1980. Contract A505-76EV03798. 42p. Dep. NTIS, PC A03/MF A01.

The objective has been to provide detailed quantities of interest to the understanding of the physical stage of the interaction of radiation with living organisms. During the past two years we have made what we believe are valuable innovations to this via the introduction of concepts of yield spectra and spatial yield spectra. These spectral functions, with their simple properties, can serve as a basis for answering almost all electron-energy deposition problems in a very convenient way. In addition to this work related to fundamental mechanisms in radiation physics, we have become professionally involved in health and public policy aspects of air pollution associated with use of fossil fuel, particularly coal. Both of these directions of research are represented in our list of attachments, our project publication list, and the publication list of the principal investigator.

19999 (PB—80-104656) **Pollutants from synthetic fuels production: sampling and analysis methods for coal gasification. Final report, August 1978-July 1979.** Gangwal, S.K.; Grohse, P.M.; Wagoner, D.E.; Minick, D.J.; Sparacino, C.M. (Research Triangle Inst., Research Triangle Park, NC (USA)). Aug 1979. 102p. NTIS, PC A06/MF A01.

The report describes sampling and analysis methods involving a laboratory-scale coal gasification facility used to study the generation, sampling, chemical analysis, process evaluation, and environmental assessment of pollutants from coal gasification. It describes methods for particulates, organic condensibles, and vapors or gases in the raw product stream of the gasifier as well as for solid residues. It describes gas chromatography (GC) procedures for measuring fixed gases, C1-C5 hydrocarbons, sulfur gases, and C6-C8 aromatics. Atomic adsorption (AA) procedures for measuring toxic trace elements include those for arsenic, selenium, lead, cadmium, chromium, and mercury. Volatile organics are collected from the gas stream using polymeric sorbents (Tenax GC and XAD-2), and analyzed by glass capillary GC/mass spectrometry (MS). The major nonvolatile byproduct (tar) is prefractionated by solvent partitioning into acid, base, and neutral fractions. Each fraction is analyzed by capillary GC/MS or high-performance liquid chromatography (HPLC). Typical results are given to illustrate the nature of the compounds studied, the methodologies, and their sensitivities.

20000 (PB—298132) **Approaching and abandoned mine lands reclamation/development plan including analysis of ARC states' programs. Final report.** Mentz, J.W.; Frakes, M.R.; Gorton, W.T.; Yuill, C.B. (Skelly and Loy, Harrisburg, PA (USA)). Jul 1978. Contract ARC-79-33/CO-6531. 372p. NTIS PC A16/MF A01.

This study produced a model plan appropriate for plan development guidance by Appalachian states. Additional efforts identified and compiled the information needed to satisfy state plan requirements. The primary users of this study are the state agencies attempting to produce State Reclamation Plans, OSM personnel who will be reviewing those plans, and the Appalachian Regional Commission. The ARC will, using this document and other available means, assist the states in plan development, and will use Skelly and Loy recommendations to incorporate economic development objectives into their ongoing reclamation programs.

20001 **History of reclamation in Wyoming.** Sundin, R.E. (Wyoming Department of Environmental Quality, Cheyenne). pp 77-79 of Rocky Mountain Coal Mining Institute: proceedings of the 75th regular meeting. Denver, CO; Rocky Mountain Coal Mining Institute (1979).

From 75. Rocky Mountain Coal Mining Institute meeting; Vail, CO, USA (24 Jun 1979).

20002 **Proposed sale of permanent easement for coal-loading barge terminal on Melton Hill Reservoir tracts XMHR-79R and XMHR-80R. Final environmental impact statement.** Knoxville, TN; Tennessee Valley Authority (1979). 328p. (NP—24339).

The action proposed in the draft environmental impact statement was the granting of a permanent industrial easement on Melton Hill Reservoir Tracts XMHR-79R and XMHR-80R. TVA does not propose to grant the easement (the no action alternative). The easement would have enabled the construction and operation of a rail-to-barge regional coal-loading facility. Environmental impacts associated with the construction and operation of the proposed facility would have included: (a) change in land use from pasture to industrial on the 64-acre site; (b) destruction of between three and four acres of riparian and shallow reservoir habitat; (c) increase in turbidity and siltation from construction and dredging operations; (d) increasing area background noise levels from facility operation; (e) adverse effects to recreation and residential areas because of noise and aesthetic impacts; and (f) impacts to floodplains and wetlands.

20003 **Draft environmental impact statement. Development of coal resources in southcentral Wyoming.** Cheyenne, WY; Bureau of Land Management (1978). vp. (DES—78-44). Information Resources Press, 2100 M Street, NW, Suite 316, Washington, DC. (MC or HC) Order No. 79-0110.

In 2 volumes.

Development of federal coal resources in the 5.5-million-acre southcentral Wyoming region in Sweetwater and Carbon counties, Wyoming and Routt and Moffat counties Colorado is proposed. Three mining and reclamation plans on existing leases would be approved. Eleven rights-of-way would be issued for support facilities, including 48.8 miles of new or relocated power transmission lines, 6.2 miles of railroad spur, 6.7 miles of relocated state highway, 1.6 miles of access and haul roads, and 3.4 miles of water pipeline.

20004 **Draft environmental impact statement. Development of coal resources in the Eastern Powder River Basin of Wyoming (revision of October 1974 final statement).** Cheyenne, WY; Bureau of Land Management (1978). 519p. (DES—78-48). Information Resources Press, 2100 M Street, NW, Suite 316, Washington, DC. (MC or HC) Order No. 79-0111.

Existing and anticipated coal development activities in the five-million-acre Eastern Powder River Basin in Campbell and Converse counties, Wyoming are considered. Also presented is an analysis of the mining and reclamation plan of the proposed Buckskin Mine, which provides for the extraction of approximately 80 million tons of low-sulfur, subbituminous coal from a 600-acre federal lease are 10 miles north of the town of Gilette in Campbell County, Wyoming. Other development activities would include coal conversion; extraction and processing of uranium, oil, and natural gas; and development of transportation and utility systems. This update of an October 1974 regional final environmental impact statement reviews the operations of nine mines approved since that time as well as five mines included in the earlier assessment that remain under consideration in separate, site-specific environmental impact statements.

20005 **Draft environmental impact statement. Proposed mining and reclamation plan, Caballo mine, Campbell County, Wyoming.** Washington, DC; Geological Survey (1978). 99p. (DES—78-43). Information Resources Press, 2100 M Street, NW, Suite 316, Washington, DC. (MC or HC) Order No. 79-0009.

A surface mining and reclamation plan is proposed for Carter Mining Company's planned Caballo mine in Campbell County, Wyoming. Mining of approximately 6700 acres (4300 acres to be actually mined) would occur in three successive pits over a 40-year period beginning in 1980. Coal would be surface-mined and transported

primarily by unit-trains using the Burlington Northern Railroad. Related facilities to be constructed on approximately 322 acres would include coal-handling and -loading facilities; administration and maintenance buildings; a warehouse; storage for explosive materials, fuel, and equipment spare parts; access roads; and a 4200-foot railroad spur. A 69-kilovolt primary transmission line would supply electric power to a substation to be built on the site. A drilled well, septic tank, and drainage field would provide potable water and sewage disposal. Reclamation would succeed mining; 40 to 530 acres would be reclaimed annually.

20006 Draft environmental impact statement. Proposed expansion of mining and reclamation plan, Big Sky Mine, Peabody Coal Company, Rosebud County, Montana. Washington, DC; Geological Survey (1978). 267p. (DES—78-51). Information Resources Press, 2100 M Street, NW, Suite 316, Washington, DC. (MC or HC) Order No. 79-0322.

Expansion of existing operations at Peabody Coal Company's Big Sky mine in Rosebud County, Montana is proposed. Surface-mining activities would occur on 894 acres of a 1,264-acre permit area covering the McKay and Rosebud seams. Existing plants, loading facilities, and haul and access roads would be expanded, and the existing rail spur from Coalstrip would be utilized. Approximately 82 acres of coal would be mined annually, and roughly 168 acres of surface would be disturbed at any one time.

20007 Draft environmental impact statement. Star Lake-Bisti regional coal. Albuquerque, NM; Bureau of Land Management (1978). vp. (DES—78-41). Information Resources Press, 2100 M Street, NW, Suite 316, Washington, DC. (MC or HC) Order No. 79-0008.

In 4 volumes.

Anticipated coal and coal-related activities in the 4.8-million-acre Star Lake-Bisti region of northwestern New Mexico are discussed. The region includes the Chaco, Rio Puerco, and San Juan planning units administered by the Bureau of Land Management and encompasses parts of McKinley, Rio Arriba, Sandoval, and San Juan counties. Two specific projects are proposed: construction by the Star Lake Railroad Company of 114 miles of railroad, and construction by the Public Service Company of New Mexico of a 108-mile, 230-kilovolt transmission line from a proposed switching station near Bisti to the Ambrosia Lake station. Potential coal production in the region is analyzed with respect to existing mines, coal development on existing federal leases, coal development not requiring federal authorization, and other related developments occurring or expected to occur within the region by 1990.

RESERVES AND EXPLORATION

20008 (PB—80-103385) **Reserves and resources of surface-minable coal in Illinois.** Treworgy, C.G.; Bengal, L.E.; Dingwell, A.G. (Illinois State Geological Survey, Urbana (USA)). 1978. 51p. NTIS, PC A04/MF A01.

In making an inventory of the amount and geographic distribution of currently minable coal in Illinois, this new study used four generalized criteria: (1) reliability of data, (2) overburden and coal thickness, (3) tonnage of blocks of coal, and (4) proximity to man-made and natural obstacles. Coal having a thickness ranging from 18 to 108 inches and occurring at depths up to 125 feet was studied.

20009 Reserves and resources of surface-minable coal in Illinois. Treworgy, C.G.; Bengal, L.E.; Dingwell, A.G. Urbana, IL; Illinois State Geological Survey (1978). 49p. (NP—24392).

Surface mining accounts for nearly 50 percent of recent coal production in Illinois. In previous publications, the Illinois State Geological Survey reported that over 20 billion tons of coal in Illinois were potentially strippable; however, current economic and environmental issues associated with surface mining have created a need for estimates of the amount of strippable coal that can be recovered economically under present conditions. In estimating strippable reserves, the criteria used were (1) reliability of data, (2) overburden and coal thicknesses, (3) the size of the block of coal, and (4) proximity to man-made and natural obstacles. On the basis of the criteria, Illinois was determined to have 6 billion tons of surface-minable coal in the ground. This reserve is made up of 185 blocks of 6 million tons or more. The amounts of strippable reserves are large in western Illinois and especially in southwestern and southern Illinois, which are more attractive for surface mining because land costs are lower, the heating value of the coal is higher, and the tonnage recoverable per acre is greater. The southwestern and southern Illinois deposits are and will continue to be the major sources of surface-mined coal in the state; however, in view of current rates of production, the remaining reserves in this area are relatively small, and opportunities for new acquisitions and long-term development are limited. Only 38 percent of the strippable reserves mapped exceed 4 feet in thickness, and most of those reserves have overburden in excess of 50 feet.

MINING

REFER ALSO TO CITATION(S) 19979, 20001, 20041, 20044, 20072, 20746

20010 (FE—8878-T1) **Evaluation of the Serpentix Conveying System. Final technical report.** (Peabody Coal Co., St. Louis, MO (USA)). Mar 1980. Contract ET-76-C-01-8878. 121p. Dep. NTIS, PC A06/MF A01.

The Serpentix Conveying System, a Peabody Coal Company underground continuous face haulage invention, was evaluated to determine its viability in room-and-pillar mining. The Serpentix is a mobile, flexible belt conveyor which is suspended from the mine roof. It was operated in the Illinois No. 6 Mine No. 1 at Marissa, Illinois and Mine No. 10 at pawnee, Illinois. Production rates in excess of 1100 raw tons per eight-hour shift were demonstrated. Conceptual designs were developed to suspend the Serpentix system from chocks for shortwall mining applications.

20011 (HCP/I76018—01) **Economic analysis of coal mining costs for underground and strip mining operation.** Katell, S. Oct 1978. 63p. NTIS, PC A04/MF A01.

Engineering economic studies have been completed and the detailed analyses are included. The first three studies are representative of room and pillar, continuous miner operations in a 72-inch coal seam located 700 to 800 feet below the surface. The capital investment and operating costs are based on mid-1977 costs. Capital investment includes both initial and deferred expenditures assuming a 20-year life for the mine. Operating costs include operating, maintenance, and supervisory personnel, power, operating supplies and overhead items. An 8% discounted cash flow analysis is detailed and establishes a selling price based on that return. Also included are analyses of three strip mining operations. The first is a contour mine typical of the Eastern region, the second is an area mine typical of the Midwest region and the third is representative of a western strip mine. The detailed studies identify the capital investment production costs and selling price.

20012 (SAND—79-2355C) **Evaluation of European empirical methods for subsidence in US coal fields.** Munson, D.E.; Eichfeld, W.F. (Sandia Labs., Albuquerque, NM (USA); Carbondale Mining Technology Center, Carbondale, IL (USA)). 1980. Contract EY-76-C-04-0789. 9p. (CONF-800507—1). Dep. NTIS, PC A02/MF A01.

From Rock mechanics symposium; Rolla, MO, USA (27 May 1980).

The intent of this study was to search out and evaluate those empirical methods of characterizing subsidence used in Europe. We need to critically access the applicability of these methods to the emerging US longwall mining practice. European methods consist essentially of (1) the graphical methods of the United Kingdom (UK), which are perhaps the best known here because of the extensive compilation of case histories by the National Coal Board (NCB), and (2) the continental methods based upon mathematical fits in the form of profile or influence functions. Initial phases of our study concentrate upon the graphical methods and the profile functions. NCB practice pertains to the longwall mining of flat lying deposits in the UK, frequently in areas of previous intensive mining of adjacent coal mineral seams. Profile functions center about two antisymmetric forms, the error integral found successful in the coal fields of Upper Silesia (Poland) and the trigonometric found successful in the Donets (USSR) coal fields. In using the empirical methods, it is essential that we recognize certain details of the subsidence trough and distinguish them. A fundamental difference occurs between those profiles which develop at right angles to the mining direction and those that develop parallel to the mining direction. We conclude that the graphical methods representing UK experience are not appropriate for the Illinois longwall mine investigated. The UK subsidence profiles are not as steep as the Illinois observations, i.e., have lower peak strains, perhaps due to the multiple seam workings common in the UK. The two profile functions examined, however, were fairly good fits to the Illinois subsidence data: the subsidence parameters from these functions were consistent between the two panels and can be used to distinguish profile types.

20013 American coal miner: a report on community and living conditions in the coalfields. Washington, DC; President's Commission on Coal (1980). 233p. (NP—24379). GPO $7.50.

This report represents the first major documentation of coal-field community and living conditions since the Boone Report of 1947, "A Medical Survey of the Bituminous-Coal Industry" was published by the Coal Mines Administration of the Department of the Interior in 1947 in response to a demand by John L. Lewis for improvements in public health and medical treatment at the mines and in the coal camps. The situation in 1979 is very different from what it was in 1947. Not only do the coal miners enjoy a much more comfortable lifestyle and significantly improved quality of health care, but also a much higher percentage of miners are employed at surface mines, many of which are now in the western States. During

the decade of the 1970s, women entered the mining work force, often after successfully seeking legal action under Federal Equal Employment Opportunity statutes. Many problems remain in the coalfields. There is vast room for improvement in the areas of housing and highways. Health care facilities and services are less extensively available than in more urban areas. Coal mining remains the most dangerous of occupations, despite considerable improvements in coal mine health and safety. The progress achieved by coal miners over their counterparts of earlier generations cannot be denied. Thirty years ago, the miner and his family were still living in coal camps, often in conditions of poverty. Today, mining communities are much more diverse, and the modern miner is, more often than not, among the resident middle class. The reality of that vast change is not widely recognized. This book concentrates on employed miners. (LTN)

20014 Rocky Mountain Coal Mining Institute: proceedings of the 75th regular meeting. Denver, CO; Rocky Mountain Coal Mining Institute (1979). 123p. (CONF-7906150—).

From 75. Rocky Mountain Coal Mining Institute meeting; Vail, CO, USA (24 Jun 1979).

The 75th regular meeting of the Rocky Mountain Coal Mining Institute was held at Lionshead Village, Vail, Colorado, June 24-27, 1979. The papers discussed US energy policy, legislation and regulations which affect the western coal industry, long-term contracts for coal purchases, dry flue gas desulfurization, labor relations, and severance taxes. Most articles have been entered individually into EDB and ERA, and one also into EAPA. (LTN)

20015 Remarks of Thomas L. Judge. pp 42-47 of Rocky Mountain Coal Mining Institute: proceedings of the 75th regular meeting. Denver, CO; Rocky Mountain Coal Mining Institute (1979).

From 75. Rocky Mountain Coal Mining Institute meeting; Vail, CO, USA (24 Jun 1979).

Through a process of elimination, we arrive at the country's best hope of energy independence, coal. The last three Presidents have all advocated dramatic increases in the production and utilization of coal to compensate for the restricted availability and escalating price of foreign oil. These initiatives have been blunted, however, by government interference and regulations which have unnecessarily impeded the mining and the burning of coal. Although coal production has expanded in recent years, we still have a long way to go in realizing the enormous potential of this resource. This country has potential coal reserves that are the energy equivalent of all of the oil in the Middle East. But at the present time, this represents more of a promise than a practical alternative to imported petroleum. Coal constitutes 82% of our total energy reserves, yet it accounts for only 18% of current needs. It is cheaper than oil or natural gas for generating electricity. It is safer and more publicly acceptable than nuclear power. It is a secure domestic source of energy which creates jobs and pays taxes in the US. This country's energy policies are a twisted wreckage of good intentions and unworkable programs that never got off the ground. In recent months there has been a growing awareness of the critical dimension of this nation's energy supply problems. Increased production and utilization of coal must be a central component of a workable national energy policy.

20016 Making unions unnecessary in the coal industry. Mitchell, B. (Human Resources Management Inc., Richardson, TX). pp 57-61 of Rocky Mountain Coal Mining Institute: proceedings of the 75th regular meeting. Denver, CO; Rocky Mountain Coal Mining Institute (1979).

From 75. Rocky Mountain Coal Mining Institute meeting; Vail, CO, USA (24 Jun 1979).

Directions for avoiding labor unions are given: (1) written goal for union-free operations; (2) hire employees, who are producers, have low absentee record and with a high probability of long tenure; (3) select good supervisors; (4) pay at least the going rate and know what the going rate is, but do not pay more than 10% above this - you can't buy loyalty; (5) group health insurance is the most important fringe benefit; (6) firm but fair work policies are necessary; and (7) upward communication should be fostered. Several mistakes that companies make in this area are discussed. (LTN)

20017 Government regulation of the US coal industry. Quarles, S.P. (Dept. of the Interior, Washington, DC). pp 88-94 of Rocky Mountain Coal Mining Institute: proceedings of the 75th regular meeting. Denver, CO; Rocky Mountain Coal Mining Institute (1979).

From 75. Rocky Mountain Coal Mining Institute meeting; Vail, CO, USA (24 Jun 1979).

TRANSPORT AND HANDLING

REFER ALSO TO CITATION(S) 19909, 19912, 19934, 20002, 20010, 20868, 21047

20018 (NP—24424) Economic aspects of the solids-water transportation of coal. Koehling, R.; Leininger, D. Translated from *Aufbereit.-Tech.;* No. 11, 574-579(1976). 14p. Dep. NTIS (US Sales Only), PC A02/MF A01.

The following conclusions can be derived from the considerations outlined above: efforts must be made to reduce as far as possible the cost of the starting and terminating stations. One way of doing this would be to set a higher upper limit on the grain size of the transported slurry and thereby design the installations for primary and secondary treatment more cheaply. The cost of dewatering must be brought down by applying the findings of the research project, Optimization of Dewatering, carried out by the Steinkohlenbergbauverein, Essen and subsidized by the Land of North-Rhine Westfalia. Efforts must continually be made to reutilize the transport water, e.g., for cooling or quenching purposes. When looking at the profitability of hydraulic coal transport, all the factors affecting cost and revenue must be taken into account. As the upper size limit is raised, knowledge of the interrelationships involved in producing a stable suspension must be extended and used for reducing costs. The multiplicity of factors and their interaction does not allow of any definitive, university valid conclusion on the profitability of hydraulic solids transport. For each possible application, the technical-economic optimum must be established with the aid of a mathematical model. The particular advantages which hydraulic pipeline transport offers for many applications guarantee a secure place for this transport technique.

COMBUSTION

REFER ALSO TO CITATION(S) 19903, 19910, 19950, 19983, 19991, 20533, 20576, 21002, 21045, 21046, 21047, 21048, 21049

20019 (CONF-790749—, pp 876-886) **Application of PFB combustion of coal in utility systems.** Slaughter, W.W.; Stringer, J. (Electric Power Research Inst., Palo Alto, CA). Dec 1979.

From Conference on advanced materials for alternate fuel capable directly fired heat engines; Castine, ME, USA (30 Jul 1979).

The Pressurized Fluidized Bed Combustor/Combined Cycle concept offers the potential for improved cycle efficiency and cost of electricity when compared to current pulverized coal-fired steam plants. Pressurized Fluidized Bed Combustor development testing has confirmed that high combustion efficiency (99%), sulfur removal of 85% or more at moderate Ca/S Mol ratios, and NO/sub x/ emissions well below anticipated regulations are achievable at typical plant design operating conditions. The PFBC exhaust gas/gas turbine interface, and specifically the balance between gas turbine erosion tolerance and hot gas particulate cleanup capability, is the technology are preventing more rapid development of the concept. Somewhat less critical development needs exist in the areas of corrosion-reistant materials qualification. Current research focus for potential utility application is on developing three commercial designs proposed by AEP/Stal-Laval, Curtiss-Wright, and General Electric.

20020 (CONF-800428—2) **Cold slumping characteristics of a fluidized bed.** Lackey, M.E.; Withers, H.W. (Oak Ridge National Lab., TN (USA); Tennessee Valley Authority, Chattanooga (USA)). 1980. Contract W-7405-ENG-26. 10p. Dep. NTIS, PC A02/MF A01.

From 6. international conference on fluidized bed combustion; Atlanta, GA, USA (9 Apr 1980).

The Tennessee Valley Authority has assumed a lead role in the demonstration of atmospheric fluidized bed combustion technology for application in large utility boilers. The first phase of this demonstration involves the operation of a 20 MW pilot plant. The pilot plant will be operated in such a manner as to allow the maximum determination of the operating characteristics of a large bed for utility application. One of the areas that will be investigated is load following capability. One method of reducing the thermal output of a fluidized bed is bed slumping, which involves the defluidization of a section of the bed and the continued opration of the remaining sections. Several areas of uncertainty are associated with this method of operation; namely, mixing between the active and slumped sections, fluidizing air bypass through the slumped section, elutriation from the fluidized section, and maximum buildup in the slumped section. As a result of tests made on a scaled down model of the pilot plant, it was found that a potential oxidizing-reducing condition can exist at the interface of the slumped and fluidized bed sections as well as a chance of crusting of the slumped section. These conditions may be prevented by supplying air to the windboxes of the slumped sections. It is recommended that this approach be allowed for in the design of the pilot plant by the installation of equipment required to meter the air flow to the windbox of each bed section that can be slumped. The approximate air metering range should be from 25 to 110% of air required for minimum fluidization of the section.

20021 (CONF-800428—3) **Technology assessment for an atmospheric fluidized-bed combustion demonstration plant.** Siman-Tov, M.; Jones, J.E. Jr. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 34p. Dep. NTIS, PC A03/MF A01.

From 6. international conference on fluidized bed combustion; Atlanta, GA, USA (9 Apr 1980).

This study assesses the atmospheric fluidized-bed combustion (AFBC) technology with respect to design, construction, and operation of a demonstration power plant in the range of 150 to 250 MW(e) capacity and identifies the most critical research and development needs for the plant project. The general conclusion of these studies is that AFBC is feasible for large power plants and that it has a generally good potential for providing an economically and environmentally acceptable alternative to conventional coal-fired power plants. Several areas of technical uncertainty must, however, be resolved in order to ensure success of an AFBC demonstration plant project. Much of the existing data base for AFBC comes from small-scale test units, and much of it is still inconclusive. A number of operational and design problems exist that do not yet have conclusive answers. A focused research and development program aimed at the early resolution of these problems should be carried out to ensure successful construction and operation of the proposed AFBC demonstration plant and early commercialization of the technology. A large flexible feeding test facility designed to investigate the feeding problems and possibilities should be constructed. A materials-test facility is also needed for testing, evaluating and selecting materials, as well as demonstrating their long-term compatibility. An intermediate-size pilot plant with sufficient flexibility to test alternate solutions to the above-mentioned problems will considerably strengthen the demonstration program.

20022 **Coal-oil mixtures--a near term combustion technology.** Kapp, G.S.; Foster, C.B. (Arthur G. McKee and Co, Cleveland, Ohio). pp vp of American Mining Congress coal conference. Washington, DC; American Mining Congress (1979).

From American Mining Congress coal convention; St. Louis, MO, USA (20 May 1979).

The US Department of Energy (DOE) is sponsoring a Coal-Oil Mixture (COM) demonstration program with an ultimate goal of generating sufficient technical and operating data to enable a rapid commercialization of COM fuels. This paper defines COM fuels, reviews current US COM work and COM technical issues, and then looks at COM economics. For the time being, coal-oil mixtures do not offer a clear economic advantage over fuel oil, although this situation may change along with the widening gap between coal and oil prices. 6 refs.

20023 (DOE/ET/10634—T1) **Investigation of fuels containing coal-oil-water emulsions fire tube test apparatus. Tenth quarterly report, January 1, 1980-March 31, 1980.** Cherry, N.H.; Stokes, C.S. (Germantown Labs., Inc., Philadelphia, PA (USA)). Jan 1980. Contract AC22-77ET-10634. 12p. Dep. NTIS, PC A02/MF A01.

The fire tube test apparatus has been checked out and is ready for the combustion test series. The stack gas analysis equipment has been calibrated and operational procedures evaluated for data acquisition. In conjunction with the fire tube test apparatus, a commercial scale size Gaulin emulsifier (100 gallons/hour) has been set up and is presently under evaluation for the preparation of COM.

20024 (DOE/MC/10484—T1) **Multi-stage desulfurizing fluid-bed combustor for coal-fired hot gas generator systems. Topical report No. 2. Task 3. Burner-pyrolyzer interactions. Task 4. Pollution measurement.** Dawson, W.F. (Wormser Engineering, Inc., Middleton, MA (USA)). Jan 1980. Contract ET-78-C-01-2859. 72p. Dep. NTIS, PC A04/MF A01.

COHOGG is a Coal Hot Gas Generator designed to allow the replacement of an oil or gas burner with an environmentally acceptable coal burner. Fluid bed coal combustors cannot provide high enough temperatures for process burners or high temperature boilers because of the limiting temperatures for clinkering (~ 2000°F) and sulfur dioxide absorption (~ 1600°F). Wormser Engineering, Inc. is developing a unique line of coal FBC's known as Wormser Grates which have several notable advantages over the typical FBC. If a partially gasifying pyrolyzer is added to a Wormser Grate system, it is possible to generate high temperature, environmentally clean flame and therefore substitute for a gas or oil burner. Coal is fed to a pyrolyzer with a low percentage of stoichiometric air to provide the heat of pyrolysis and partially gasify the coal. The resultant gases are fed to an afterburner and the char is fed to a Wormser Grate, where it is burned with excess air to maintain the bed temperatures at the optima for combustion efficiency and SO_2 clean-up. The char burner combustion products with the excess air are fed to the afterburner where they burn the pyrolyzer gases to produce the ~ 3000°F flame. The COHOGG system is highly efficient and low in cost. The high efficiency results from (a) no in-process gas clean-up requiring a large loss of sensible heat, and (b) high carbon utilization because only partial gasification occurs in the pyrolyzer and the upper bed in the Wormser Grate provides additional fines burn-up. The capital cost is low since the reactor sizes are similar to other gasification systems.

20025 (DOE/MC/12063—T1) **User's manual for atmospheric fluidized bed combustor system economic performance algorithm computer program.** (TRW, Inc., McLean, VA (USA). Energy Systems Group). Dec 1979. Contract AC21-79MC12063. 81p. Dep. NTIS, PC A05/MF A01.

The computer program calculates several economic and energy terms, given various performance and cost parameters, for a system composed of coal, a coal beneficiation (cleaning) plant, a combustor plant and an associated flue gas desulfurization (FGD) plant. The combustor can be either an atmospheric fluidized bed combustor (AFBC) or a conventional pulverized (CP) combustor. The FGD system is a lime-slurry system.

20026 (DOE/NASA/2593—80/15) **Flame tube parametric studies for control of fuel bound nitrogen using rich-lean two-stage combustion.** Shultz, D.F.; Wolfbrandt, G. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1980. Contract EF-77-A-01-2593. 26p. (NASA-TM—81472; CONF-800408—2). Dep. NTIS, PC A03/MF A01.

From Conference of the western states section of the Combustion Institute; Irvine, CA, USA (21 Apr 1980).

A flame tube was used in experimental parametric studies of two-stage, rich-lean combustion to evaluate techniques for minimizing the conversion of fuel-bound nitrogen to nitric oxides in a premixed, homogeneous combustion system. Air at 670°K and 0.48 MPa was premixed with fuel blends of propane, toluene, and pyridine, then burned at primary equivalence ratios of 0.5 to 2.0 and secondary equivalence ratios of 0.5 to 0.7. These fuel mixtures were proportioned to yield hydrogen compositions of 9.0 to 18.3 wt % and fuel nitrogen compositions of 0 to 1.5 wt %. Two distillates of a coal syncrude produced by the SRC-II process also were tested for NO/sub x/ emissions and the results compared with the propane-toluene-pyridine data. In addition to oxides of nitrogen, the exhaust gas was sampled for carbon monoxide, carbon dioxide, unburned hydrocarbons, and smoke. Rich-lean two-stage combustion was successful in reducing the conversion rate of fuel-bound nitrogen. Rates of less than 10% were observed for the optimum primary equivalence ratios, which ranged between 1.4 and 1.73 with a secondary equivalence ratio of 0.5. Fuel hydrogen and nitrogen content both influenced the values at which the optimum primary equivalence ratio occurred. The amount of fuel-bound nitrogen also affected conversion rate, since the conversion rate dropped as fuel nitrogen content increased. Exhaust NO/sub x/ levels, however, still increased with additional fuel nitrogen.

20027 (FE—2473-T7) **DOE cost comparison study industrial fluidized bed combustion vs conventional coal technology.** Myrick, D.T. (Combustion Engineering, Inc., Windsor, CT (USA). Power Systems Group). 2 Jan 1980. Contract EX-76-C-01-2473. 51p. Dep. NTIS, PC A04/MF A01.

This study compares the capital and operating costs of two different industrial boiler technologies, each producing 250,000 lbs steam/hr. These technologies are: Fluidized Bed Combustion (FBC) and Pulverized Coal (PC) combustion used in conjunction with a limestone Flue Gas Desulfurization (FGD) system. Three separate turnkey plant designs have been completed. Two of these plant designs incorporate FBC technology and have been designated FBA-16 and FBV-16. The first FBC design (FBA-16) contains two shop assembled, rail shippable fluid bed boilers capable of producing 125,000 lbs/hr each. The second plant design (FBV-16) utilizes a single 250,000 lbs/hr fluid bed boiler shipped by rail in large sections for field assembly. The third plant design utilizes a conventional pulverized coal (PC) boiler in conjunction with a C-E Air Quality Control System (AQCS) limestone scrubber. Capital costs were generated for the three turnkey plant designs just described. The FBA-16, FBV-16, and Conventional Unit plant designs have associated capital costs of $24.4, $22.8, and $24.7 million, respectively. Comparisons between plant capital cost estimates are valid and informative. The total operational costs, which include contingencies on new product design for the Fluid Bed Units, were found to vary between four and seven percent higher than the Conventional Unit. When contingencies are not included, the operating costs were found to be between one and three percent higher than the Conventional Unit. As can be seen, the operating costs for the bed designs are close enough to be considered similar when considering the nature of the study. The efficiency of the fluid bed plant designs can be increased and required capital equipment reduced by improvements to the plant design with time and more development. Some potential design modifications are outlined.

20028 (FE—2473-T8) **Industrial application of fluidized bed combustion. Phase I, Task 4: sub-scale unit testing and data analysis. Volume II. Final report.** Goodstine, S.L.; Accortt, J.I.; Harris, R.D.; Kantersaria, P.P.; Matthews, F.T.; Jones, B.C.; Jukkola, G.D. (Combustion Engineering, Inc., Windsor, CT (USA)). Dec 1979. Contract EX-76-C-01-2473. 321p. Dep. NTIS, PC A14/MF A01.

20029 (FE—2612-13) **Advanced coal-fueled combustor/heat exchanger technology study.** Campbell, J.C. Jr. (Rockwell International Corp., Canoga Park, CA (USA). Rocketdyne Div.). Jun 1978. Contract EF-77-C-01-2612. 266p. Dep. NTIS, PC A12/MF A01.

Much of the rationale for studying the coal-fired, closed-cycle, gas turbine, power generation system lies in two factors. The closed-cycle gas turbine power system, which utilizes a non-condensing working fluid, is capable of higher overall thermal efficiencies than is the conventional steam based Rankine system utilized in present day steam power stations. It utilizes higher working fluid temperatures to achieve this higher efficiency. Additionally, the utilization of the closed-cycle as opposed to the open gas turbine cycle, isolates the turbomachinery from the products of coal combustion. These coal combustion products are so dirty, corrosive, and erosive that no practical system for their direct utilization in gas turbines has yet been devised, and near term achievement of practical coal-fired, open-cycle gas turbines appears unlikely. The direct coal firing of heat exchangers, by comparison, is present day state-of-the-art at the lower working fluid temperatures typical of today's steam based power cycles. The operating requirements for the coal-fired combustor/heat exchanger of a closed-cycle gas turbine power conversion system differ from those of steam boilers in several respects, particularly as regards maximum heating surface temperatures. But they are sufficiently similar that the attainment of technology readiness for such combustor/heat exchangers is expected to be attainabled for modest development costs and in the near future, thus permitting more efficient utilization of the only economically abundant US fuel, coal. The effort contracted under EF-77--01-2612 consisted entirely of studies, analyses, design effort and reporting. No fabrication or test effort was involved.

20030 (FE—2652-T7) **Prototype anthracite culm combustion boiler/heater unit, City of Wilkes-Barre, Pennsylvania. Quarterly technical report No. 4, July 1-September 30, 1979.** (Wilkes-Barre, City of, PA (USA)). 1979. Contract ET-78-C-01-2652. 41p. Dep. NTIS, PC A03/MF A01.

A program was initiated in October 1978 to design, construct and evaluate a 100,000 ppH AFB steam generator burning anthracite culm with the addition of fresh anthracite, if required. The unit is to demonstrate the technical, economical and environmental feasibility of producing 150 psig saturated steam for district heating in downtown Wilkes-Barre. Phase I of the program consists of the deisgn of the atmospheric fluidized bed (AFB) plant and a hot model test program.

20031 (FE—2762-8) **Formation and control of fuel-nitrogen pollutants in catalytic combustion of coal-derived gases. Quarterly technical progress report, March 15-June 15, 1979.** Bracco, F.V.; Bruno, C.; Santavicca, D.A.; Semler, J.H.; Walsh, P.M. (Princeton Univ., NJ (USA). Dept. of Mechanical and Aerospace Engineering). 1 Jul 1979. Contract EF-77-S-01-2762. 53p. Dep. NTIS, PC A04/MF A01.

A review was made of the available data on amounts of nitrogen-containing impurities present in coal-derived low and medium-Btu gases. A summary was made of the most complete of the existing models for catalytic combustor operation. A summary of the theoretical and experimental work on ammonia conversion to NO/sub x/ in catalytic combustion of low and medium-Btu gases is given in this report. Experimental investigations were made of carbon monoxide and medium-Btu gas combustion in the presence of platinum supported on a monolithic Cordierite substrate. Axial profiles substrate temperature, gas temperature, and stable species concentrations were measured at different gas velocities and equivalence ratios. The carbon monoxide data were presented in a progress report and at the Third Workshop on Catalytic Combustion. The medium-Btu gas data were presented in the last progress report. These results have been extended by investigation of the catalytic combustion of medium-Btu gas containing hydrogen sulfide, described in this report. The two-dimensional computer model being developed to describe catalytic combustion has been expanded by addition of finite rate wall reactions to the chemical kinetic scheme. Computed axial and radial gas temperature and carbon monoxide concentration profiles inside a catalyst channel during carbon monoxide combustion are presented. The integrated carbon monoxide profiles at the catalyat outlet are compared with the experimentally measured values. A possible approach to minimizing ammonia to SO/sub x/ conversion in catalytic combustion of coal-derived gases is presented.

20032 (FE—3269-16A) **Design, construction, operation and evaluation of a prototype culm combustion boiler/heater unit.** (Dorr-Oliver, Inc., Stamford, CT (USA)). Sep 1979. Contract ET-78-C-01-3269. 80p. (CW-WR—78-036-16A). Dep. NTIS, PC A05/MF A01.

A preliminary design of a prototype anthracite culm combustion boiler was initiated under the DOE Contract ET-78-C-01-3269. The prototype boiler is being designed to generate 20,000 pounds per hour of 150 psig saturated steam using low Btu (4,000 Btu per pound) anthracite culm as a fuel. This boiler will be located at the industrial park of the Shamokin Area Industrial Corporation. This program is directed at demonstrating the commercial viability of anthracite culm fueled FBC steam generation systems.

20033 **How to burn coal efficiently and economically, and meet air pollution requirements: the fluidized-bed combustion process. Report to the Congress by the Comptroller General of the United States.** Staats, G.B. Washington, DC; General Accounting Office (1979). 55p.

One of the key factors limiting coal use is the measures that must be taken to burn it in a manner that does not pollute the environment. Fluidized-bed combustion is one of the Department of Energy's research, development, and demonstration programs which has the potential to burn coal more efficiently and economically than conventional coal-fired boilers with pollution control equipment. Since 1973, the Department of Energy and its predecessor agencies have spent $176 million developing the new process. In addition, the Tennessee Valley Authority, the State of Ohio, utilities, research organizations, and boiler manufacturers have been funding research for the technology. Other countries, including the United Kingdom, Sweden, and West Germany, have also been interested in fluidized-bed combustion. Its basic concept is sound and it works. Small scale units have been operating successfully for years. But in order to commercialize the technology, its reliability under industrial and utility loads must be demonstrated. To achieve this demonstration, the Department's demonstration program could be improved through complementary strategies. Specifically: placing industrial-size demonstration units in Department of Defense industrial plants could demonstrate the technology while making needed replacements of old fossil fuel boilers; entering into an interagency agreement with TVA to host the utility demonstration plant would take advantage of TVA's past research and development efforts and in-house expertise; and also, the merits of continuing construction of a research facility called a component test and integration unit should be reevaluated in view of questions raised concerning its usefulness. DOE agreed that this program should be accelerated but disagreed with these specific recommendations.

20034 (LBL—10416) **Combustion research FY 1979.** (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1980. Contract W-7405-ENG-48. 62p. Dep. NTIS, PC A04/MF A01.

Combustion research at the Lawrence Berkeley Laboratory focuses on the study of chemical and physical processes which are important in utilizing new fuels while limiting pollutant formation. A second component of the combustion research is concerned with reduction of fire hazards associated with energy generation and conservation technologies. Principal program areas include the interaction of fluid-mechanical turbulence and combustion, pollutant formation and destruction processes, physical and chemical diagnostic techniques for combustion research, theoretical and computational modeling of combustion processes, combustion processes in engines, flame propagation, and fire safety. Thirty combustion research programs are identified and described briefly.

20035 (METC/CR—79/1) **Systems study of commercial scale atmospheric fluidized-bed combustion with appendices.** (TRW Energy Systems Group, Morgantown, WV (USA)). Feb 1979. Contract EY-77-C-21-8085. 616p. Dep. NTIS, PC A99/MF A01.

A preliminary investigation was performed to define the optimum technical and economic conditions for control of sulfur emissions in a system comprised of coal preparation, atmospheric fluidized-bed combustion (AFBC) and flue gas desulfurization. Using a simplified model, a methodology has been developed for quantitative evaluation of AFBC systems that incorporate front-end coal cleaning and tail-end flue gas cleanup to meet EPA criteria for sulfur removal. The major factor investigated was the split in desulfurization among the three subsystems (coal cleaning, AFBC, and FGD), while maintaining the total level of desulfurization constant. The methodology can also serve to guide AFBC research programs, because it includes the sensitivity of AFBC economics to operating conditions. Based on the assumptions and selected cases used, several conclusions can be reached. The minimum cost of product (either electricity or steam) coincided with the point of lowest heat rate (highest efficiency) and highest system sorbent consumption (for both AFBC or FGD) in four of the five coal/application combinations that were studied. On the same four cases, minimum cost occurred when all the desulfurization was accomplished in the fluid-bed combustor, with no prior coal cleaning or flue-gas desulfurization. The optimization of any coal cleaning AFBC/FGD system is highly dependent on the input coal characteristics and the end-use application. Sorbent consumption and electric generating cost or heat rate cannot be simultaneously minimized; however, the cost minima are fairly broad in many cases, so some system flexibility is possible without great cost increases.

20036 (STUDSVIK/E4—79/72) **Description of an experimental model for combustion in a fast fluidized bed.** Harju, R. (Studsvik Energiteknik AB, Nykoeping (Sweden)). Jul 1979. 35p. Dep. NTIS (US Sales Only), PC A03/MF A01.

This report describes an experimental model for combustion in a Fast Fluidized Bed (FFB). The model is designed both for cold flow and combustion experiments. The model can be fired with coal and domestic fuels and it is rated at 250 kW. Descriptions of the different parts of the model are presented, as well as the measurement equipment and data acquisition system. Some experiences from operating the model are presented.

20037 (NP—24423) **Cyclone furnace for brown coal.** Schulze, R. Translated from *Energie;* 6: No. 5, 141-148 (15 May 1954). 19p. Dep. NTIS (US Sales Only), PC A02/MF A01.

The operating time of the brown coal cyclone boiler has so far been too short to give a definite opinion on its operation under continuous running. The initial difficulties with this new design, on which there was no previous experience, were in no way greater than with other known boiler and furnace types. The three months operation have shown that the specified figures have been confirmed and that the new design has come up to expectations in all essentials. The boiler plant operates reliably, and the cyclone furnace can be rapidly and flexibly adjusted to the steaming requirements. The boiler rating and efficiency, the slag flow and fusion rate, the crusher/drier efficiency and power consumption are satisfactory, and the real economy obtained in steam raising compares well with other furnaces firing Rhineland brown coal. As the result of the good experience obtained, a second cyclone boiler for firing brown coal has been ordered. This will be constructed as a Benson boiler with two cyclones for a steam output of 200 t/h, a pressure of 176 atmospheres and a steam temperature of 535°C.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 19908, 19924, 19928, 19958, 19961, 20011, 20245, 20246, 20565, 20566, 20755, 21237

20038 (FE—2468-64) **Coal technologies market analysis. Final report.** (Engineering Societies Commission on Energy, Inc., Washington, DC (USA)). Jan 1980. Contract EF-77-C-01-2468-016. 59p. Dep. NTIS, PC A04/MF A01.

This report presents an analysis directed to the greater use of coal to displace foreign petroleum. It examines the US energy system in the year 1990 under the assumption of Federal laws and policies as existed in the last half of 1979 - in particular, the National Energy Act of 1978 and the new energy initiatives announced by the President in July 1979. Energy production, flow, and use patterns for the year 1978 are developed. Starting with this historical base, the constraints and initiatives identified by the National Energy Act and the President are used to develop a plan for the decade of the 90's that is technically feasible and economically viable. The end-use energy demands for the year 1990 are matched with estimated available domestic energy sources including coal, natural gas, petroleum, nuclear, hydro and other solar. The required scale of coal technology to supply future needs is established. Distillate fuels (transportation fuels) are identified as the critical barrier to reducing foreign oil dependence. Synthetic fuels from coal - with the emphasis on transportation fuels - offer the only solution available to eliminate this barrier in the remainder of this century. Although the necessary synfuels plants will require a capital investment of some $60 billion during the next ten years, this investment is 25% of that which is also needed in the same period for new coal-fired electric power plants.The implications of moving toward a coal-based economy, a discussion of present technology trends, and an action plan for eliminating the critical barrier to reducing petroleum imports are presented.

20039 (FE—2468-68) **Survey of world coal energy studies and international coal mining research.** Boyce, T.A. (Engineering Societies Commission on Energy, Inc., Washington, DC (USA)). Dec 1979. Contract EF-77-C-01-2468-012. 80p. Dep. NTIS, PC A05/MF A01.

In March 1978, an international monitoring task was undertaken by the ESCOE staff. This is a continuing effort to maintain an awareness of international energy programs which may parallel or supplement DOE or ESCOE fossil energy programs. This report is a summary of the findings of the monitoring activities to date that have emphasized coal studies and coal mining research. The report is divided into three sections: World Coal Energy Studies, International Coal Mining Research, and World Coal Trade. The contents of these sections should be considered only as brief overviews of work going on outside of DOE and not as exhaustive listings of all activities in the field. Where possible, the conclusions and recommendations as reported by several studies and projects have been included in this report. Many of the studies and projects are ongoing and will continue to be monitored. The major idea behind this monitoring task is a recognition that the promise and problems of coal are truly global in nature. Supply and demand for coal must be studied from an international perspective.

20040 (ORNL/TM—7197) **Regional development implications of alternative future coal production patterns.** Bjornstad, D.J. (Oak Ridge National Lab., TN (USA)). Apr 1980. Contract W-7405-ENG-26. 37p. Dep. NTIS, PC A03/MF A01.

The manner in which BEA functional economic areas may respond to alternative levels of exogenous local economic stimuli is examined by using a multiregional projections model. Two alternative futures describing coal production, one emphasizing heavy eastern development and the other emphasizing heavy western development, are analyzed using the MULTIREGION model. The study indicates that quite different development patterns may occur in the east and west. In the east, coal development tends to generate a greater stimulative effect in regions hosting coal development proximate to the older core coal producing regions than in the core areas themselves. Growth from coal tends to spill out to non-producing regions as well. In the west, the greatest stimulative effects occur in major producing regions. However, rather than stimulating growth in non-producing regions, larger producing regions tend to compete with non-producing regions and even with smaller producing regions for growth. It is emphasized that these findings result from examining the outputs of a regional systems model which is specified to capture regional interactions. For this reason, events in a given region affect those in others, and the model outputs permit examining the process of regional growth in a more general way than would be possible were regional independence assumed.

20041 **Long term coal contracts.** Natta, F.L. (Utah International, Inc., Craig, CO). pp 48-57 of Rocky Mountain Coal Mining Institute: proceedings of the 75th regular meeting. Denver, CO; Rocky Mountain Coal Mining Institute (1979).

From 75. Rocky Mountain Coal Mining Institute meeting; Vail, CO, USA (24 Jun 1979).

From its outset, the western coal industry has relied on the long-term contract as its primary sales mechanism. A cursory review indicates at least 30 such agreements in existance today, accounting for about 92 million tons of coal sales annually. The underlying reasons for long-term sales relationships are: (1) coal is not a fungible commodity such that its quality is often unique to every mine. Power plants are often specifically designed to burn one coal type thereby optimzing operational efficiencies; (2) coal is a low, unit-value commodity where transportation plays a key role such that the situation lends itself to high-volume, continuous transportation systems - unit trains; (3) the cost of new development in terms of capital, manpower, and lead times is so great that such commitments are not feasible without a reasonable guarantee of success; (4) relative to the high capital costs of new consuming facilities, coal as a source of energy is a vital, primary material input; and (5) market stability, in terms of commodity costs and/or prices, benefits both buyers and sellers in the long run. The contract agreement is discussed under three headings: (1) the logistics or the what, when, and where of the sale; (2) pricing provisions; and (3) commercial and legal factors such as invoicing and arbitration provisions.

20042 **Where in the world are we going in severance taxation.** Allen, J.O. (Wyoming Taxpayers Association, Cheyenne). pp 73-76 of Rocky Mountain Coal Mining Institute: proceedings of the 75th regular meeting. Denver, CO; Rocky Mountain Coal Mining Institute (1979).

From 75. Rocky Mountain Coal Mining Institute meeting; Vail, CO, USA (24 Jun 1979).

The growth in taxes on coal mining in Wyoming in the past 10 years is reviewed. (LTN)

HEALTH AND SAFETY

20043 (PB—298973) **Mining surveillance: potentially toxic occupational exposures.** (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). May 1979. 23p. NTIS, PC A02/MF A01.

The document has been prepared pursuant to Section 101(a)(6)(B) of the Federal Mine Safety and Health Act of 1977. That Section states that the Secretary of Health, Education, and Welfare '... shall for each toxic material or harmful physical agent which is used or found in a mine, determine whether such material or agent is potentially toxic at the concentrations in which it is used or found in a mine.' The Act allows eighteen months after the date of enactment for the transmittal of the first determinations to the Secretary of Labor. Subsequent determinations will be developed and transmitted on a continuing basis after the initial report. The Act designates the National Institute for Occupational Safety and Health (NIOSH) as the agency in the Department of Health, Education, and Welfare responsible for health research in mines. In this first transmittal under Section 101(a)(6)(B) of the Act, NIOSH reports thirty-five agents found to occur in mines at potentially toxic concentrations.

REGULATIONS

REFER ALSO TO CITATION(S) 19916, 20017, 20529, 20747

20044 (DOE/EV/10286—4) **Analysis of the Office of Surface Mining estimates of the cost of implementing the surface mining control and reclamation act.** (Hart (Fred C.) Associates, Inc., New York (USA)). Dec 1979. Contract AC02-79EV10286. 29p. Dep. NTIS, PC A03/MF A01.

This report has focused on the adequacy of OSM's cost estimates for implementation of SMCRA's discretionary regulations. In considering whether the Regulatory Analysis included the proper regulations and subparts we determined that only three discretionary regulations were not assessed in the RA. Our analysis of the model mine data base concluded that D'Appolonia Consulting Engineers used sound bases for their cost estimates. There were no apparent methodological errors. In estimating the costs of those additional discretionary regulations which should have been included in the Regulatory Analysis, only one such regulation was found to have a significant or measureable implementation cost. While this cost should have been included in OSM's cost estimate, it amounts to an increase of only three percent in the estimated cost of complying with the discretionary regulations. The Regulatory Analysis should be viewed in its proper light. It is an attempt to estimate the cost of complying with SMCRA's discretionary regulations. It is not an attempt to measure the total cost of implementing SMCRA. It has been shown to be, generally, an accurate analysis.

20045 **Government regulation of the US coal industry.** Reeves, P.L. (Dept. of the Interior, Washington, DC). pp 83-85 of Rocky Mountain Coal Mining Institute: proceedings of the 75th regular meeting. Denver, CO; Rocky Mountain Coal Mining Institute (1979).

From 75. Rocky Mountain Coal Mining Institute meeting; Vail, CO, USA (24 Jun 1979).

20046 **Government regulation of the US coal industry.** Loesch, H. (Peabody Coal Co., Washington, DC). pp 85-88 of Rocky Mountain Coal Mining Institute: proceedings of the 75th regular meeting. Denver, CO; Rocky Mountain Coal Mining Institute (1979).

From 75. Rocky Mountain Coal Mining Institute meeting; Vail, CO, USA (24 Jun 1979).

20047 **Government regulation of the US coal industry: state's position.** Gray, D.E. (Water Rights Bureau, Santa Fe, NM). pp 95-97 of Rocky Mountain Coal Mining Institute: proceedings of the 75th regular meeting. Denver, CO; Rocky Mountain Coal Mining Institute (1979).

From 75. Rocky Mountain Coal Mining Institute meeting; Vail, CO, USA (24 Jun 1979).

PETROLEUM

REFER ALSO TO CITATION(S) 19893

20048 (BNL—51076) **Physical aspects of the US oil and gas systems.** D'Acierno, J.; Hermelee, A. (Brookhaven National Lab., Upton, NY (USA)). Nov 1979. Contract EY-76-C-02-0016. 118p. Dep. NTIS, PC A06/MF A01.

The purpose of this report is to describe the physical operations which take place within the petroleum and natural gas industries of the US. This information was the basis for the overall network design and the detailed data requirements for the Emergency Management Information System (EEMIS) of the US Department of Energy (DOE). Since EEMIS represents the entire oil and gas systems this report can be used to obtain a basic understanding of the entire energy system, from production to consumption, that is composed of the US oil and gas industries.

GEOLOGY AND EXPLORATION

20049 (GRI—78/0023) **Hydrocarbon source facies analysis: Department of Energy and General Crude Oil Company, Pleasant Bayou No. 1 and 2 Wells, Brazoria County, Texas.** (GeoChem Labs., Inc., Houston, TX (USA)). Aug 1979. 122p. Dep. NTIS, PC A06/MF A01.

The stratigraphic sections penetrated by the Department of Energy/General Crude Oil Company No. 1 and No. 2 Pleasant Bayou Wells, Brazoria County Texas, over the combined interval of 2072+- feet to 16,500+- feet, can be divided into three major zones based on the organic geochemical characteristics of the fine-grained sediments. Upper Zone A Sediments, 2072+- feet to 5000+-, have an immature, very poor to poor oil and associated gas source character. No producible quantities of either liquid or gaseous hydrocarbons have been generated within this section in the general vicinity of this well. Middle Zone B Sediments, 5000+- feet to 11,800+- feet, represent a sedimentary section that has an immature thermal character, and for the most part a very poor to poor source potential. However, a thin interval from 6850+- feet to 7400+- feet does have a minor dry gas source potential. Lower Zone C Sediments, 11,800+- feet to 16,500+- feet T.D., represent a sedimentary section which has experienced a thermal regime which grades from immature to moderately immature. Accompanying the thermal increase is an overall source potential which increases from very poor in the subzone c_1 to poor in the subzone c_2. Even considering this increase in relative potential, the entire section is interpreted as having no potential for indigeously generating producible quantities of either liquid or gaseous hydrocarbons.

20050 **Usefulness of sulfur isotope ratios in crude oil correlations.** Gaffney, J.S.; Premuzic, E.T.; Manowitz, B. (Brookhaven National Lab., Upton, NY). *Geochim. Cosmochim. Acta;* 44: No. 1, 135-139(Jan 1980).

Sulfur isotope analyses have been completed for twelve samples of marine Jurassic oils from a single basin, and are presented along with previous chemical analyses of the same oils (SEIFERT and MOLDOWAN, 1978). Two isotopic anomalies are discussed in light of correlational analyses, and show that sulfur isotope ratios, when used with other chemical variables, are sensitive indicators of subtle changes in initial source input. Measurements of $\delta\ ^{34}S$ in correlational studies of crude oil characterization and identification are recommended. 4 figures, 1 table.

20051 **Merits and potential of a proposed ocean drilling program for the 1980's: the report of the Committee on Post-IPOD Science.** Washington, DC; National Science Foundation (1979). 54p. (NP—24378).

The highly successful Deep Sea Drilling Project (DSDP), in existence for more than twelve years, began sea-going operations when the Glomar Challenger embarked on Cruise 1 in August 1968. The scientific architects and advisors to the project, a consortium known as the Joint Oceanographic Institutions for Deep Earth Sampling (JOIDES), were encouraged to review both operations and accomplishments, and to recommend what, if any, should be a program for the 1980's. Although the recommended program was a logical follow-on of current deep-sea drilling, it was apparent that new and more expensive technology would be required. In particular, a larger and more capable drilling vessel would be needed. To undertake this new program would require a major financial commitment. Therefore, in evaluating its merits and desirability, the National Science Foundation has undertaken a three-stage process. First, an evaluation of the scientific importance of the project; second, an assessment of the technological requirements and engineering feasibility of the operations; third, an overall evaluation of the importance of this program in the context of national scientific effort and of other national priorities. Stage I has been completed, and the aims of the project have been endorsed. Stage II is continuing, but all indications are that the program is technologically feasible. To accomplish Stage III, the Foundation established a Committee on Post-IPOD Science to look at this new program in terms of other national interests and priorities and recommend its relative importance. The report of this committee is presented.

DRILLING AND PRODUCTION

REFER ALSO TO CITATION(S) 20065, 20740

20052 (DOE/EA—0098) **Environmental assessment. Downhole steam generator field test project DEEP STEAM: enhanced oil recovery project (DOE No. 16), Kern County, California.** Church, H.W.; Zak, B.D. (Sandia Labs., Albuquerque, NM (USA)). Feb 1980. Contract EY-76-C-04-0789. 31p. (SAND—79-0908). Dep. NTIS, PC A03/MF A01.

Objective of DEEP STEAM is to develop the technology to economically produce heavy oil from reservoirs greater than 760 m deep using steam injection. The proposed site is in the Kern River Oil Field in the San Joaquin Valley. This document describes the project, existing environment, and possible impact of the project. It is concluded that the proposed action does not significantly affect the quality of the environment, and therefore an environmental impact statement is not required. (DLC)

20053 (PB—80-100498) **Radius of pressure influence of injection wells. Final report, March 1977-January 1979.** Warner, D.L.; Koederitz, L.F.; Simon, A.D.; Yow, M.G. (Missouri Univ., Rolla (USA)). Aug 1979. 216p. NTIS, PC A10/MF A01.

It is often necessary, in injection well design, to predict the probable rate of pressure increase in the injection reservoir that would be expected to result from a proposed injection program.

Areas of application include oilfield brine injection, waterflooding for secondary oil recovery, industrial wastewater injection, uranium leaching, etc. This report presents a number of available analytical solutions that can be used for pressure buildup calculation and three methods of performing such calculations. The methods are, manual calculation, calculation by programmable desk calculator, and calculation by digital computer.

20054 (PB—297852) **Methodologies for OCS-related facilities planning. Onshore facilities related to offshore oil and gas development.** Nothdurft, W.E. (New England River Basins Commission, Boston, MA (USA)). Mar 1978. 162p. NTIS PC A08/MF A01.

Methodologies presents a systematic method of planning for offshore oil and gas development. It includes developing hypothetical offshore scenarios of OCS oil and gas activity, estimating the number and kind of onshore facilities required to support a given level of offshore activity, and identifying and assessing the impacts of alternative sites for onshore facilities. Methodologies for site identification and impact analysis accommodate both the industry's site requirements for facilities, and state, local, or county policies concerning economic development and environmental conservation as equal criteria for site selection.

20055 Oil and gas well blowout prevention in California. Second edition. Hallmark, F.O.; Wygle, P.R. Sacramento, CA; California Division of Oil and Gas (1978). 59p. (NP—24233).

Section 3219, Division 3, of the Public Resources Code states that operators will equip wells with adequate casing and safety devices to prevent blowouts, explosions, or fires. This manual discusses the safety devices or blowout prevention equipment (BOPE) considered necessary by the State Oil and Gas Supervisor for oil and gas wells drilled in California. The manual classifies the BOPE, describes the function and operating characteristics, and outlines inspection and testing procedures. (DLC)

20056 Oil and Gas Conservation Division annual review for the year 1978. Volume 22. Oil and gas. Helena, MT; Montana Department of Natural Resources and Conservation (1978). 50p. (NP—24371). Montana Dept. of Natural Resources and Conservation, P.O. Box 217, Helena, MT.

Drilling for petroleum and natural gas in Montana for 1978 is reviewed. Geological and geophysical explorations are summarized. The number of producing wells is tabulated. Overall oil and natural gas production for the state is discussed. (DC)

PROCESSING

REFER ALSO TO CITATION(S) 20318

20057 Hydrocarbon conversion with an acidic multimetallic catalytic composite. Antos, G.J. (to UOP Inc.). US Patent 4,003,826. 18 Jan 1977. Filed date 28 Oct 1975. 22p.

Hydrocarbons are converted by contacting them at hydrocarbon conversion conditions with an acidic multimetallic catalytic composite comprising a combination of catalytically effective amounts of a platinum group component, a tin or lead component, a lanthanide series component, and a halogen component with a porous carrier material. The platinum group component, tin, or lead component, and halogen component are present in the multimetallic catalyst in amounts respectively, calculated on an elemental basis, corresponding to about 0.01 to about 2 wt % platinum group metal, about 0.01 to about 5 wt % tin or lead, and about 0.1 to about 3.5 wt % halogen. The lanthanide series component is present in amounts corresponding to an atomic ratio of lanthanide series component to platinum group metal of about 0.1:1 to about 1.25:1. Moreover, these metallic components are uniformly dispersed throughout the porous carrier material in carefully controlled oxidation states such that substantially all of the platinum group metal is present therein in the elemental metallic state, while substantially all of the tin or lead component and of the lanthanide series component are present therein in oxidation states above that of the corresponding metal. A specific example of the type of hydrocarbon conversion process disclosed in a process for the catalytic reforming of a low-octane gasoline fraction wherein the gasoline fraction and a hydrogen stream are contacted with the novel acidic multimetallic catalyst disclosed herein reforming conditions.

PRODUCTS AND BY-PRODUCTS

REFER ALSO TO CITATION(S) 20748

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 20740, 20748

20058 (NP—24329) **Annual report, 1978.** (Wirtschaftsverband Erdoel- und Erdgasgewinnung e.V., Hannover (Germany, F.R.)). 1978. 63p. (In German). Dep. NTIS (US Sales Only), PC A04/MF A01.

The report contains tables with figures on petroleum and natural gas production, petroleum and natural gas reserves in West Germany. Other subjects are drilling, geophysical activities of the German petroleum and natural gas industries abroad.

20059 Historic and projected oil and gas consumption. Goldsmith, S.; O'Connor, K. Anchorage, AK; State of Alaska, Department of Natural Resources (1980). 58p. (NP—24353).

The petroleum and natural gas consumption in Alaska since 1970 is tabulated. Projected use between 1980 and 2000 is estimated. Petroleum and natural gas reserves in Alaska are estimated. Royalty oil and natural gas status is summarized. Lists of leases and owners are included. (DC)

20060 New Jersey's petroleum refining industry. Minde, T.A. Trenton, NJ; New Jersey Department of Labor and Industry (1979). 102p. (NP—24374). Office of Economic Research, Trenton, NJ.

Factors which have led to the existence of a petroleum refining industry in New Jersey, a state with no known petroleum reserves, are examined. An historical analysis is presented. The period 1956 through 1977 was selected for special study. The following topics are discussed: refining capacity in the USA; petroleum refineries in New Jersey; sources of crude oil for the US market; petroleum product pipelines serving New Jersey; New Jersey as a distribution center for petroleum products; and employment in New Jersey's petroleum refining industry. (DC)

20061 NP—24404. (Oil and gas consumption in Alaska, 1976-2000). Goldsmith, S.; Lane, T. Anchorage, AL; Alaska Department of Natural Resources (1978). 112p.

Demand for petroleum liquids is projected to increase at an annual 6% growth rate between 1976 and 2000 based upon the assumption of strong economic growth resulting in increases in petroleum liquids usage in all major categories. Use of petroleum liquids for electricity generation is minimized after 1985 with coal fired generation or hydroelectric power meeting new demand where feasible. Growth in natural gas use over the same period will be at a much slower 2% rate. This is predicated upon the assumptions of Federal legislation significantly limiting the ability of Alaskan electric utilities to expand their gas-fired generation facilities. In addition, this projection is made under the assumption of no significant increase in industrial use of natural gas beyond existing facilities. Coal and hydroelectric power will grow more rapidly in the future to meet rising needs for electric power generation and will supply an increasing proportion of the state's future energy requirements. Royalty oil from known reserves could, if necessary, supply a large portion of the instate market through the year 2000. There is no Alaskan demand for petroleum liquids which would be endangered were royalty oil all exported from the state. Royalty gas from Cook Inlet cannot meet projected requirements in the Cook Inlet market. Total existing reserves (committed and uncommitted) are sufficient to meet existing needs through 2000 but provide little allowance for unforeseen requirements and demands beyond that date. Likewise, Prudhoe Bay royalty gas, were it feasible to supply the Cook Inlet market would not be sufficient to meet existing needs in that market. Total royalty gas from both Prudhoe Bay and Cook Inlet would also be insufficient. Therefore, it will be necesssary to supplement and/or substitute for the state's royalty gas in meeting projected natural gas demands.

20062 Historic and projected demand for oil and gas in Alaska: 1972-1995. O'Connor, K. Anchorage, AL; Alaska Department of Natural Resources (1977). 51p. (NP—24403).

This current analysis of oil and natural gas demand in Alaska was prepared for the Alaska Royalty Oil and Gas Development Advisory Board and the State legislature in response to AS 38.05.183 (d). Previous oil and gas demand studies were completed by this author and others through the Division of Geological and Geophysical Surveys in response to AS 38.06.070 (2). The bibliography accompanying this report contains a complete list of the analyses upon which this report is based. Other State agencies and consultants have contributed to the state of the art in Alaskan demand analyses, and this report also draws on their experitise. At the time of this study, only data through 1975 were available. Oil and gas comsumption information for 1976 will be available soon and may be compiled for a midyear report. The Division of Minerals and Energy Management also plans to recompute the demand forecasts using the 1972 through 1976 historic consumption data. Included in this report are: (1) the historic oil and natural gas consumption from 1972 through 1975; (2) the projected demand for oil and natural gas to

1995; and (3) an addendum tabulating existing oil and gas fields and resources in Alaska.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 20052, 20954, 21153, 21154, 21196, 21235, 21236

20063 (AD-A—075231) **Modifications to the vulnerability model: a simulation system for assessing damage resulting from marine spills. Final report.** Tsao, C.K.; Perry, W.W. (Enviro Control, Inc., Rockville, MD (USA)). Mar 1979. Contract DOT-CG-33377-A. 63p. NTIS, PC A04/MF A01.

This report describes several modification to the U.S. Coast Guard Vulnerability Model which have recently been incorporated. These modifications are in three areas: 1. Revisions of the plume and puff model for toxic damage assessment, to include remodeling of the plume model to reduce computer time and storage space, computing the dosage for the puff model by direct integration, and transferring dosage values computed in Phase I of the Vulnerability Model directly to Phase II. 2. Revision of thermal injury and the lethality criteria in Phase II based on recent applicable experimental thermal effects data. 3. Remodeling of the flash fire for puff and plume models to compute thermal radiation during both burning and cooling phases for experimentally determined burning rates and maximum surface temperatures.

20064 (PB—80-102635) **Design, fabrication and testing of the air-jet oil boom. Final report.** Cohen, S.H.; Lindenmuth, W.T. (Hydronautics, Inc., Laurel, MD (USA)). Jun 1979. Contract EPA-68-03-2497. 139p. NTIS, PC A07/MF A01.

This novel boom has the capability to divert oil slicks under wave and current conditions that normally preclude the development of conventional booms. Tests at the EPA's OHMSETT facility have demonstrated that this boom can divert oil slicks at 3 knots with 85 percent efficiency when at 30 degrees to the flow. Moreover, with the addition of steep, 4-foot waves, the boom's performance is virtually unchanged. The key operational feature is a continuous, horizontally oriented air jet ejected from along the boom at the water's surface. Overall, each boom module is about 33 feet long and 2 feet in diameter. Major components include two inflatable sections (ducts) to support the continous air-jet nozzle and a center support float/jet pump. Some unique features of the structural design are low draft (1 inch) and excellent compliance to waves. Furthermore, the sections are both lightweight and highly compactible for storage.

20065 **Environmental aspects of enhanced oil recovery.** Donaldson, E.C. (Bartlesville Energy Technol Cent, Okla). *Energy Sources (N.Y.);* **4**: No. 3, 213-229(1979).

Oil displacement by injection of brines (the waterflood process) entails the surface processing of large quantities of saline waters, creating the potential for pollution of surface waters and shallow freshwater aquifers. Improved waterflooding techniques involve the introduction of surface active agents (detergents), caustics, and organic polymer compounds (particularly polyacrylamide), thus increasing the potential of pollution. It is increased further by the micellar-polymer process, since the micellar solution is a mixture of surfactant, oil, water, and a cosurfactant (usually an alcohol). Enhancement of oil production by thermal methods adds another dimension to the environmental hazards through air pollution from steam generators and the produced fluids. Other field operations, such as drilling and renovation of wells, create local environmental hazards, but these are becoming regional concerns as the search for new oil and the reactivation of old oil fields accelerates. This paper presents the potential pollution hazards of the enhanced oil-recovery processes and the environmental surveillance program being instituted by the Department of Energy (DOE).

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 21556

20066 **Institute on oil and gas law and taxation.** Ernst, A.C. (ed.). New York, NY; Matthew Bender (1979). 673p. (CONF-790250—).

From 30. annual institute on oil and gas law and taxation; Dallas, TX, USA (14 Feb 1979).

This volume contains discussions, by acknowledged authorities, of important legal and tax problems of the oil and gas industries. The articles were delivered in condensed form as lectures during the Thirtieth Annual Institute on Oil and Gas Law and Taxation held by the Southwest Legal Foundation. The following topics are discussed: crude oil issues; natural gas liquid-selected problems in regulation; recent developments in DOE audits of refiners and marketers; contrasting administrative procedures before the DOE, DOE organization - the limit of regulatory power, current major developments in federal natural gas legislation and regulation; dedication and abandonment - problems under section 7(b) of the Natural Gas Act; Natural gas pipelines - their regulation and their current problems, current antitrust developments in oil and gas exploration and production; developments in nonregulatory oil and gas law; recent developments in oil and gas taxation; entity selection - an experience in alchemy - a comparison of corporations, partnerships, and joint ventures; foreign money and US oil and gas - tax considerations; 1978 legislative developments in oil and gas taxation; and recapture of intangibles under section 1254. (DC)

TRANSPORT, PIPELINES, AND HANDLING

20067 (EPRI-EA—1256) **Oceanborne transportation of liquefied natural gas, petroleum, and methanol fuels. Final report.** Hynes, J.P.; Dahlgren, J.; Aguilar, M.A. (Manalytics, Inc., San Francisco, CA (USA)). Dec 1979. 223p. NTIS, PC A10/MF A01.

Because there is a strong demand for natural gas, and because domestic supplies are dwindling, there is considerable interest in importing liquefied natural gas (LNG) in special carriers (LNGC). The complex design of the LNGCs and the need to process the gas before and after shipment result in very high transportation costs for LNG. Typically LNG importers also have domestic sources of natural gas, and the high cost of the imported gas is averaged (rolled-in) with that of the domestic gas so that the resulting price is competitive with other fuels. The quantity of LNG imported will be limited less by economic and technical constraints than by government policies concerning energy imports and the siting of terminal facilities. Imported and domestic US petroleum movements were considered separately, since petroleum imports are carried primarily in foreign-flag ships and domestic movements must by law be carried in unsubsidized US-flag ships. There is currently an oversupply of foreign-flag tankers of over 60,000 deadweight tons; the existing fleet will be adequate to carry international movements of oil through 1985 barring any event which might greatly increase the distances over which oil must be transported. By 1990 however, new tankers of over 60,000 DWT will be needed to meet increased oil transportation requirements and to replace those which have been scrapped. New foreign-flag tankers of less than 60,000 DWT will be needed before 1985. World shipyard capacity should be adequate to supply the needed tankers. There is a shortage of large unsubsidized US-flag tankers for carrying Alaskan oil to Panama for transshipment by smaller tankers to the US Gulf and Atlantic coasts. The Maritime Administration has allowed subsidized US-flag tankers to participate temporarily in this trade.

PROPERTIES

REFER ALSO TO CITATION(S) 21021, 21022

COMBUSTION

REFER ALSO TO CITATION(S) 20022, 20023

20068 (EPRI-AF—1243) **Worldwide survey of current experience burning residual and crude oils in gas turbines. Final report.** Buckland, B.O.; Kindl, F.H.; Lukas, H. (Encotech, Inc., Schenectady, NY (USA)). Dec 1979. 87p. Dep. NTIS, PC A05/MF A01.

The purpose of the project was to survey owners of gas turbines burning residual fuel to identify operating problems, costs, and general owners' reaction to burning residual fuel. Owners were contacted by mail and personal visits and the results are summarized in this report. The general conclusion is that residual oil is a practical fuel for gas turbines. Capital and operating costs will be higher and extra attention to system design is required as compared with distillate operation. When the cost differential between distillate and residual (or crude) fuel justifies it, residual is a practical alternative.

NATURAL GAS

REFER ALSO TO CITATION(S) 20048, 20777

RESERVES

REFER ALSO TO CITATION(S) 19979

GEOLOGY AND EXPLORATION

20069 (CONF-800102—3) **Economic aspects of hydropressured aquifer gas production.** Doherty, M.G. (Institute of Gas Technology, Chicago, IL (USA)). 1980. 12p. Institute of Gas Technology, Chicago, IL.

From International conference on geotechnical and environmental aspects of geopressure energy; Sea Island, GA, USA (13 Jan 1980).

While hydropressured aquifers may not seem to be an economic source of gas at this time, there are certain conditions under which they may appear very attractive. Hydropressured aquifers containing methane are known to exist over a large area of this nation. The site-specific conditions must be examined before any final conclusion can be made. Hydropressured aquifer research can lead beyond consideration of simply producing brine and gas. More information about dispersed gas, watered-out wells, relative permeabilities, and exploration strategies are needed before the special high grade locations for methane production from hydropressured aquifers can become practical. 4 figures, 3 tables.

20070 (DOE/ET/12137—T1) **Geologic remote sensing over the Cottageville, West Virginia, gas field. Final report, August 15, 1977-February 15, 1979.** Jackson, P.L.; Wagner, H.L.; Shuchman, R.A. (Environmental Research Inst. of Michigan, Ann Arbor (USA). Applications Div.). Feb 1979. Contract AC05-77ET12137. 93p. Dep. NTIS, PC A05/MF A01.

Remote sensing of geologic features was investigated for the purpose of exploration for gas reserves in the eastern Mississippian-Devonian Shales. The Cottageville gas field in Jackson and Mason Counties, West Virginia, was used as a test site for this purpose. Available photographic and multispectral (MSS) images from Landsat were obtained; also 4-channel synthetic aperture radar and 12-channel MSS in the range between ultraviolet and far infrared were gathered by the Environmental Research Institute of Michigan over the test site. The images were first interpreted visually for lineaments. Then the images were enhanced by many different digital computation techniques in addition to analysis and enhancement by optical techniques. Subtle, interpretative lineaments were found which could not be enhanced to an obvious level by the procedures used. Two new spatial enhancement procedures were developed.

DRILLING, PRODUCTION, AND PROCESSING

REFER ALSO TO CITATION(S) 20054, 20055

HEALTH AND SAFETY

20071 (UCID—18539) **Effect of humidity on the energy budget of a liquefied natural gas (LNG) vapor cloud.** Haselman, L.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Feb 1980. Contract W-7405-ENG-48. 14p. Dep. NTIS, PC A02/MF A01.

The effect of the humidity of the air on the dispersion of the vapor rising from a liquefied natural gas (LNG) spill is studied. A theory was developed relating the temperature of a mixture of air and methane to the percent of methane in the mixture. The theoretical results are compared with experimental measurements. In general it was found that the experimental temperature was higher than expected, suggesting that additional heat was added to the plume. Several mechanisms for this addition are evaluated.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 20058, 20059, 20061, 20062

ENVIRONMENTAL EFFECTS

REFER ALSO TO CITATION(S) 21167, 21235, 21236

ARTIFICIAL STIMULATION, PLOWSHARE, ETC.

20072 (LA—8155-C) **Alternative gas workshop. Final report.** Cremer, G. (comp.). (Los Alamos Scientific Lab., NM (USA)). Mar 1980. Contract W-7405-ENG-36. 58p. (CONF-7909133—). Dep. NTIS, PC A04/MF A01.

From Alternative gas workshop; Los Alamos, NM, USA (5 Sep 1979).

The Alternative Gas Workshop met at the Los Alamos Scientific Laboratory on September 5 and 6, 1979, to review basic research needs in the development of seven categories of unconventional and nonconventional gas resources. The categories reviewed were Devonian shales, western tight gas sands, methane from coal beds, geopressured brines, methane hydrates, abiogenic methane, and other geological environments. This report presents the principal recommendations of the workshop groups.

20073 (SAND—80-0114C) **In situ evaluation of several tailored-pulse well-shooting concepts.** Schmidt, R.A.; Warpinski, N.R.; Cooper, P.W. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 21p. (CONF-800525—1). Dep. NTIS, PC A02/MF A01.

From SPE/DOE symposium on unconventional gas recovery; Pittsburgh, PA, USA (18 May 1980).

This paper describes a series of five full-scale tests performed to evaluate various multi-frac concepts. The tests were conducted at the Nevada Test Site in cased, horizontal boreholes drilled in ash-fall tuff from a tunnel under 430 m of overburden. This site provides both realistic in situ conditions for the tests and access to the stimulated regions by mineback which permits direct observation of results. The five tailored-pulse concepts tested involve: Case A - a decoupled explosive, Case B - a decoupled explosive with propellant booster, Case C - a small-diameter propellant charge with pressurized water pad, Case D - three successive shots of Case C, and Case E - a full-diameter charge of a progressively-burning propellant. Results show a large increase in formation permeability for Case E, modest increases for Cases B, C, and D and a decrease for Case A that appears due to the formation of a stress cage. A comparison of Case E results with previous tests suggests a multiple fracture criterion based on pressure rate with little effect of peak pressures.

20074 (UCRL—83784) **Effects of various parameters on hydraulic fracture geometry.** Hanson, M.E.; Anderson, G.D.; Shaffer, R.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). May 1980. Contract W-7405-ENG-48. 20p. (CONF-800525—3). Dep. NTIS, PC A02/MF A01.

From SPE/DOE symposium on unconventional gas recovery; Pittsburgh, PA, USA (18 May 1980).

Theoretical models have been applied to analyze some aspects of the dynamics of fracturing near material interfaces. Results of these calculations indicate that variation of material properties across a well bonded interface can cause dynamic material response resulting from the fracturing which could enhance propagation across the inerface. Effects of friction have also been analyzed theoretically; however, in the frictional calculations the wave mechanics have been ignored. These calculations have shown that frictional slip along the interface tends to draw a pressurized fracture toward the interface; this motion tends to reduce the chances of penetrating the material across the frictional interface. Small scale laboratory experiments are performed to study the effects of frictional characteristics on hydraulic fracture growth across unbonded interfaces in rocks. Various lubricants and mechanical preparation of the interface surfaces are used to vary the coefficients of friction on the interface surfaces. It is found that the frictional shear stress that the interface surface can support determines whether a hydraulically driven crack will cross the interface. Pre-existing cracks impede the propagation of the hydraulic fracture across the interface. These experimental results on the effects of friction on the interface and the effects of pre-existing cracks on hydraulic fracture penetration of interfaces are consistent with the predictions of the numerical model calculations. 11 figures.

20075 **Potential for increasing production of natural gas from existing fields in the near term. Final report to the Secretary of the Interior.** Washington, DC; National Academy of Sciences (1978). 120p. (NP—24370).

In April 1977, the Secretary of the Interior asked the National Research Council (NRC) to convene a committee to assess the opportunities for increasing the production of natural gas for federal leases in the Gulf of Mexico during the next one to five years. The NRC Committee was asked to select for detailed study five to seven fields with high potential for increasing production, and to identify the opportunities for and impediments to accelerating deliveries from these fields. The present report summarizes the detailed studies of the six specific fields, discusses important issues raised in the analyses, and draws some general conclusions about accelerating gas production from existing fields in the near term. The report, focusing on the future, addresses the question of whether existing fields can be relied on to supply additional gas in the near term. The primary conclusions of the study follow, together with brief summaries of the findings on which they are based: of the six fields studied in detail, only the Tiger Shoal Field offers significant opportunities for physically increasing production from proved reserves in the near term; with one exception, the fields studied have significantly smaller reserves than were reported by the US Geological Survey before this study was undertaken; and, if the production histories of the fields examined in our study are typical, existing fields in the Gulf of

Mexico Outer Continental Shelf appear to offer negligible prospects for increased production of natural gas in the near term.

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 20066, 21556

TRANSPORT, PIPELINES, AND HANDLING

REFER ALSO TO CITATION(S) 20067

STORAGE

REFER ALSO TO CITATION(S) 20867

OIL SHALES AND TAR SANDS

REFER ALSO TO CITATION(S) 19893

RESERVES AND EXPLORATION

20076 **Tapping the vast tar sand reserves of the U.S.** Cupps, C.Q.; Marchant, L.C : Stosur, J.J. (DOE, Laramie Energy Technol Cent, Wyo). *World Oil;* **189**: No. 4, 73-76, 78(Sep 1979).

Oil recovery from some 550 known tar sand occurrences in the U.S. could significantly deter energy crises in the long term. Continuing research and field testing are providing a new base of knowledge and experience for eventual economic exploitation. This article reports on current research and field activity.

DRILLING, FRACTURING, AND MINING

REFER ALSO TO CITATION(S) 21051

OIL PRODUCTION, RECOVERY, AND REFINING

20077 (LETC/RI—80/5) **Fluid flow through packed columns of crushed oil shale.** Minster, R.A.; Fausett, D.W. (Department of Energy, Laramie, WY (USA). Laramie Energy Technology Center). Apr 1980. 38p. Dep. NTIS, PC A03/MF A01.

This report presents the results of an engineering analysis of the pressure drop occurring when a fluid is passed through a packed column of crushed, raw oil shale. An equation of the Ergun type was found to give a good fit to pressure drop data generated by an experimental program. The experimental apparatus and procedure are described. The method of analysis is discussed, and an example of its application is included.

IN SITU METHODS, TRUE AND MODIFIED

REFER ALSO TO CITATION(S) 20076, 20091, 20092

20078 (SAND—80-0364) **Minimum bed parameters for in situ processing of oil shale. First quarterly report, October 1-December 31, 1979.** Tyner, C.E. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 21p. Dep. NTIS, PC A02/MF A01.

To minimize the costs and environmental impact associated with the material removal involved in in-situ processing, it is important to determine the minimum conditions (of void, permeability, etc.) actually required for a viable in situ process. This problem is being investigated through laboratory studies and mathematical modeling. The laboratory program this quarter centered around design, fabrication, and initial testing of a new retort vessel and system. Model calculations were made with Sandia's block retorting code in this geometry to determine the most appropriate operating conditions for the run. The ignition heater design used in the first attempt to ignite the sample was unsatisfactory, and, as a result, sustained combustion was not achieved.

20079 (UCRL—83739) **Investigation of critical parameters in modified in-situ retorting.** Campbell, J.H.; Raley, J.H.; Ackerman, F.J.; Sandholtz, W.A.; Libicki, S.B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Apr 1980. Contract W-7405-ENG-48. 15p. (CONF-800425—5). Dep. NTIS, PC A02/MF A01. From 13. oil shale symposium; Golden, CO, USA (16 Apr 1980).

Recent results from operation of a 6 metric ton simulated, modified in-situ retort show that high (up to 3 m/day) retorting rates can be achieved with high (85%) oil yield and acceptable (<1000°C) maximum temperature. These results were obtained with a bed of Colorado shale of broad (-30, +0.001 cm) size range containing a stepped grade change from 75 to 150 l/metric ton. Process control by steam and air injection rates, as stipulated by prerun model calculations, was demonstrated as was continuous estimation of retorting rate and oil yield from off-gas composition.

20080 (UCRL—83742) **Determination of product yield for oil shale retorting using oil analysis using capillary column chromotography.** Burnham, A.K.; Clarkson, J.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Apr 1980. Contract W-7405-ENG-48. 11p. (CONF-800425—4). Dep. NTIS, PC A02/MF A01. From 13. oil shale symposium; Golden, CO, USA (16 Apr 1980).

A method is described for determining the oil yield from a combustion retort using only the capillary column chromotogram of the oil. The heating rate and/or retorting temperature and the resulting yield loss by oil coking is determined from the 1-alkene/n-alkane ratios. The amount of combustion and associated cracking is determined from naphthalene/straight-chain hydrocarbon ratios. The utility of this method is demonstrated using oil samples from several large-scale retorting operations. The possibility of using the oil mist from an in-situ retort for an on-line determination of the current retort performance is discussed.

20081 **BX in situ oil shale project.** Dougan, P.M. (Equity Oil Co, Salt Salt City, Utah). *Chem. Eng. Prog.;* **75**: No. 9, 81-84(Sep 1979).

This paper describes a research program, the BX In-Situ Oil Shale Project, the purpose of which is to demonstrate the technical feasibility of using superheated steam at 1000$degree$F (538$degree$C) and 1,500 psig (10,343 kPa gauge) as a heat carrying medium to retort in situ oil shale of the Leached zone, and provide a mechanism for the recovery of this oil with a minimum impact on the environment. More specifically, the oil shale shall be retorted by injecting superheated steam into the Leached zone through an array of injection wells, and recovering the steam/water/oil and gas produced from the Leached zone through an array of production wells. The injection into, and production from, the Leached zone will be accomplished in a manner that will promote a diagonal sweep of the entire Leached zone. During a two-year period, approximately 1*10$sup 12$ Btu (1.055*10$sup 15$ J) of heat shall be injected into a Leached zone site, which is approximately 165 m thick and covers about 9,293 m$sup 2$. The project is being performed under a cooperative agreement between Equity Oil Co. and the U.S. Department of Energy (DOE). The agreement was entered into on March 1, 1977. The duration of the project is estimated to be 55 months. By July, 1978, Task 1, the Leached zone site evaluation, had been completed, and work was in progress on the other three tasks. This article deals with the results of the Leached zone site evaluation and the resulting design of the field project.

20082 **Igniting in situ oil shale retorts.** Gumerman, R.J. (Chevron Res Co, Richmond, Calif). *Chem. Eng. Prog.;* **75**: No. 9, 85-86(Sep 1979).

This article discusses a technique to evaluate the various ways an in situ retort can be ignited. Heat transfer, gas flow, and combustion equations are modeled to show how a combustion front develops in time. The model is applied to the case when a number of isolated ignition points are distributed over the upper surface of the rubblized shale bed. The study indicates that in situ retorts should be lit evenly across the upper surface. There are a variety of ways to accomplsih this. For example, the entire upper surface of the shale bed can be preheated to ignition temperature using burner exhaust gas. When the entire upper surface is above ignition temperature, air can be admitted above the bed, and the upper surface will ignite.

20083 **Hydrocarbons from eastern oil shale.** McNamara, P.H.; Humphrey, J.P. (Dow Chem Co, Midland, Mich). *Chem. Eng. Prog.;* **75**: No. 9, 87-91(Sep 1979).

The Dow Chemical Co., under a contract with the U.S. Dept. of Energy, is conducting a four-year, research program to test the feasibility of deep, in situ recovery of a low-heat content gas from the Michigan Antrim shale. From experiments reported it is concluded that the kinetics of retorting of Antrim shale appear to be significantly different from those of Western shales. Mapping and other basic studies of the Antrim shale are being done to determine the extent of this resource. Explosive fracturing in mechanically underreamed wells has not produced extensive rubblization. Three new approaches, involving hydrofracturing, chemical underreaming and explosive underreaming are being tested at the Dow oil shale site in Michigan. Extraction trials in wells with and without explosive fracturing have produced gases with energy values of about 50 Btu/std ft$sup 3$ (1,860 kJ/std m$sup 3$). Ignition has been

achieved using an electric heater and a propane burner. Augmentation of the ignition energy source with charcoal and coal has not been of apparent benefit in these trials.

20084 Results of computer simulation of in situ oil shale retorting. Braun, R.L. (Univ of Calif, Lawrence Livermore Lab). *In Situ;* 3: No. 3, 173-207(1979).

A mathematical model has been developed for simulating the processes involved in the in-situ retorting of rubblized beds of oil shale. The model is a transient, one-dimensional treatment of a packed-bed reactor. The predicted retorting results for conditions of interest to commercial, modified, in-situ retorting are discussed in detail. The initial shale properties, such as grade, carbonate content, and bed porosity, are shown to have an important bearing on the maximum retort temperature, the rate of retorting, and the oil yield.

SURFACE METHODS

20085 (UCRL—83740) **Some relationships of thermal effects to rubble-bed structure and gas-flow patterns inol shale retorts.** Sandholtz, W.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Mar 1980. Contract W-7405-ENG-48. 10p. (CONF-800425—3). Dep. NTIS, PC A02/MF A01.

From 13. oil shale symposium; Golden, CO, USA (16 Apr 1980).

To characterize bed structure and measure fluid dispersion under varied flow conditions, conventional tracer measurements in packed beds rely on detection of specific molecular species. The work reported here demonstrates the use of temperature sensors, such as thermocouples, to develop similar kinds of information from thermal data. In oil shale retorts (that is, packed beds in which the process is driven by heat transfer from a flowing medium to the rubble), much can be inferred about bed and void structure and flow patterns from the time-temperature relationships among thermocouple arrays placed in the bed. The use of temperature data as a bed diagnostic tool in oil shale retorting experiments is shown. For combustion retorting, the close relationships between the thermal effects produced by condensing steam and those produced by retorting are illustrated. This thermal logging technique has proved useful in understanding laboratory retorting experiments and predicting retort performance. 5 figures, 6 tables.

REFINING

REFER ALSO TO CITATION(S) 19957

20086 Alternative routes for refining Paraho shale oil. Frumkin, H.A.; Owens, E.J.; Sutherland, R.B. (Chevron Res Co, Richmond, Calif). *Chem. Eng. Prog.;* 75: No. 9, 64-72(Sep 1979).

The work reported in this paper was performed under contract with the U.S. Department of Energy to produce transportation fuels from Paraho shale oil using advanced commercial petroleum processing technology. Studies discussed are based on laboratory and pilot plant work published fully in the government report. The primary basis for the first six cases is the production of a fixed amount of finished transportation fuels (LPG, motor gasoline, kerosene jet fuel, and/or diesel fuel) in a "grass roots" refinery, that is, a complete, new refinery that includes all necessary supporting facilities such as utility plants, tankage, and required environmental control equipment. Extensive experimental data are presented, including comprehensive cost estimates.

20087 Light olefins from hydrogenated shale oil. Griswold, C.F.; Ballut, A.; Kavianian, H.R.; Dickson, P.F.; Yesavage, V.F. (Colo Sch of Mines, Golden). *Chem. Eng. Prog.;* 75: No. 9, 78-80(Sep 1979).

The recent national concern for developing new sources of energy has increased interest in creating ways to utilize the vast reserves of oil shale in the United States. Typically, crude shale oil has a high content of organic nitrogen ($congruent$2 wt%). Since nitrogen is a poison to current refinery catalysts and a detriment to the finished products, existing refineries would not be able to cope with the high nitrogen content of raw shale oil if it were a substantial part of the refinery feed unless upgrading involving severe denitrification is added prior to the refining steps. This paper reports on an experimental program which was undertaken in order to utilize the raw shale oil (containing high level of nitrogen compounds) for the production of petrochemicals, particulary of ethylene, by using steam pyrolysis. The effects of feed composition, operating variables, and nitrogen level on product distribution were studied. The first stage of the overall research program was to design and build a steam pyrolysis unit. Tests were then carried out on crude shale oil from the Tosco II retorting process and on a "simulated in-situ" oil from the Laramie Energy Research Center's 150-ton retort. Next, tests were carried out on vacuum distillates of these two crude shale oils. It is demonstrated that steam pyrolysis of hydrogenated shale oil gives yields of major gaseous components that compare well with those from petroleum fractions, and even higher yields of ethylene.

PROPERTIES AND COMPOSITION

REFER ALSO TO CITATION(S) 19957

20088 (SAND—79-2312C) **Stress-relaxation in oil shale.** Olsson, W.A. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 15p. (CONF-800507—5). Dep. NTIS, PC A02/MF A01.

From Rock mechanics symposium; Rolla, MO, USA (27 May 1980).

It is shown that oil shale from Anvil Points, Colorado of grades 132 and 284 ml/kg can be accurately represented by a linear viscoelastic constitutive law. A prediction based on this law with the constants evaluated from stress-relaxation tests, predicts almost exactly the correct constant strain-rate, stress-strain response. An indirect method to determine whether the material is a visco-eleastic solid or fluid was advanced and implicitly verified. 7 figures.

HEALTH AND SAFETY

20089 (CONF-7904131—1) **Work plan for shale oil study paraho/sohio refinery samples cellular bioassays animal toxicology.** Rao, T.K.; Epler, J.L. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 16p. Dep. NTIS, PC A02/MF A01.

From EPA-ORNL synfuels meeting; Research Triangle Park, NC, USA (25 Apr 1979).

A proposed approach to answering questions of relative toxicities of shale oil process materials and refinery products involves a parallel, two-level program. Level one is cellular bioassays which will accumulate baseline data on typical effluents and emissions and ascertain how the relative toxicity of major effluents and fractions thereof vary as a function of changes in process conditions. Biological-effects studies using cellular assays will also provide an essential data base for eventual determination of correlation with whole animal, acute, and chronic, toxic effects. Level two consists of the mammalian toxicity bioassays which will involve characterization of the acute, subacute, and chronic toxicity of primary process precursors and products.

20090 (LA-UR—80-876) **Oil shale health and environment research.** Holland, L.M.; Tillery, M.I. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 11p. (CONF-800334—4). Dep. NTIS, PC A02/MF A01.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

While there have been sporadic efforts to demonstrate certain shale oil extraction technologies in recent years, none of the techniques have been thoroughly analyzed to determine the extent of potential occupational health impacts and even those technologies that have been demonstrated cannot be regarded as typical of a scaled-up, fully mature industry. Industrial hygiene studies have served to identify operations within certain technologies where mitigating methods can and should be applied to protect the industrial populations. Judging from data developed by on-site sampling it is probable that, with the possible exception of MIS techniques, oil shale mining presents no unique problems that cannot be handled with state-of-the-art control procedures. The conditions that may exist in a mine where in situ retorts are being simultaneously prepared, burned and abandoned have not as yet been defined. The probability of combined exposures to spent shale dusts and fugitive emissions in the form of vapors and gases added to the potential for skin exposure to product oils and other liquid effluents raises more complex questions. It has been shown by both epidemiological evidence and experimental data gathered both in the US and in foreign industries that crude shale oil and some of its products carry a higher carcinogenic potential than most of the natural petroleums. Preliminary data suggest that this particular hazard may be almost self-eliminating if hydrotreating, in preparation for refining, is universally practiced. The determination of specific hazards should be done on a technology-specific basis since it is highly probable that the biological activity of most of the products and by-products of shale oil production is process-specific.

ENVIROMENTAL ASPECTS

REFER ALSO TO CITATION(S) 21182, 21190, 21235, 21236

20091 (DOE/LETC/IC—80/1) **Environmental survey - tar sands in situ processing research program (Vernal, Uintah County, Utah).** Skinner, Q. (Wyoming Univ., Laramie (USA). Rocky Mountain Inst. of Energy and Environment). Mar 1980. Contract EY-77-C-04-3913. 171p. Dep. NTIS, PC A08/MF A01.

Research will be done on the reverse-forward combustion and steam injection for the in-situ recovery of oil from tar sands.

This environmental survey will serve as a guideline for the consideration of environmental consequences of such research. It covers the construction phase, operational phase, description of the environment, potential impacts and mitigations, coordination, and alternatives. (DLC)

20092 (FE—2346-56) **Environmental monitoring and analysis in support of Antrim oil shale research.** Thomas, G.S.; Tanis, F.J.; Doak, E.; Laurin, R. (Environmental Research Inst. of Michigan, Ann Arbor (USA). Applications Div.; Dow Chemical Co., Midland, MI (USA)). Apr 1980. Contract EX-76-C-01-2346. 95p. Dep. NTIS, PC A05/MF A01.

A program to assess environmental impacts of in situ Antrim oil shale processing experiments was carried out. This report covers the third year of an expected four year program. Activities included: monitoring of surface elevations for possible subsidence; monitoring for soil contamination from brines; monitoring surface and subsurface water quality; and monitoring ambient air quality. Assessment was also made of on- and off-site vegetation, some site soils, surface disruption caused by drilling activities, and impacts on neighboring residents. Much of this year's effort was directed to monitoring baseline conditions. Consequently, assessment of potential impacts from in situ operations is not yet possible.

20093 (PB—297984) **Surface water quality parameters for monitoring oil shale development. Final report.** Kinney, W.L.; Brecheisen, A.N.; Lambou, V.W. (Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab.). Mar 1979. 156p. NTIS PC A08/MF A01.

This report develops and recommends prioritized listings of chemical, physical, and biological parameters which can be used to assess the environmental impact of oil shale development on surface water resources. Each of the potential water-related problems is addressed in the context of the probable cumulative regional impact of a maturing, commercial oil shale industry and in terms of local impact resulting from the prototype operation initially planned on leased public lands. The possible effects of potential pollutants on ambient water quality and the resulting impact on aquatic life, public water supplies, livestock, irrigation agriculture, and selected industries are evaluated.

REGULATIONS

20094 (UCRL—83738) **Oil shale: a framework for development.** Lewis, A.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Apr 1980. Contract W-7405-ENG-48. 8p. (CONF-800425—2). Dep. NTIS, PC A02/MF A01.

From 13. oil shale symposium; Golden, CO, USA (16 Apr 1980).

The price escalation of petroleum in recent times has removed the economic barrier to shale oil production, or soon will. A technological base for production is available which can be rapidly developed to the size and quality needed. The resource base in the Piceance Creek Basin of Colorado can support production of 1 to 5 million barrels of oil per day for hundreds of years. Institutional problems are the major remaining impediment to the development of oil shale. The small part of the resource in private hands is economically marginal and cannot support large production rates or the most efficient methods. The best land is owned by the Federal Government and is unavailable under present laws and policies. The lack of an integrated federal policy and an implementation plan prevents the development that is now technically and economically practical. One possible solution is a Piceance Basin Authority chartered by Congress to efficiently manage this resource and coordinate the federal governmental responsibility for oil shale resource development and conservation, water development, environmental control, and land use policy. It should be located in Colorado for an effective interaction with State and local authorities where both have responsibility. Government lands must be made accessible on a scale suitable to the technology and in a way that is acceptable to the public and to industry. Government and industry can then cooperate in a unitized, coordinated development of the resource and the area. With access to the resource and a clear government responsibility for area-wide, non-commercial planning and development, industry can provide the technology and capital for production and marketing of shale oil on an economically competitive basis.

NUCLEAR FUELS

RESERVES

20095 (LA—8281-PR) **Oklo-natural fission reactor program. Progress report, October 1, 1979-December 31, 1979.** Norris, A.E. (Los Alamos Scientific Lab., NM (USA)). Mar 1980. Contract W-7405-ENG-36. 12p. Dep. NTIS, PC A02/MF A01.

The study of lead, ruthenium, and technetium transport in nature requires the mass spectrometric analyses of large numbers of geologic samples. This quarter about 200 samples arrived from Gabon, which were collected at the Oklo mine in September. Work was performed to improve the lead and ruthenium chemical procedures and the mass spectrometric instrumentation in preparation for analyzing many of the Oklo samples and a large number of the 402 samples on hand from Key Lake, Canada. Data concerning ruthenium isotopic alterations from samples near an Oklo natural fission reactor zone indicated that ruthenium or technetium were not transported to distances greater than the 10 meters detected previously.

20096 (STI/PUB—509) **Uranium deposits in Africa: geology and exploration. Panel proceedings series.** (International Atomic Energy Agency, Vienna (Austria)). Dec 1979. 262p. (In French and English). (CONF-771168—). IAEA.

From Meeting on uranium deposits in Africa; Lusaka, South Africa (Nov 1977).

Fourteen papers were presented in two sessions: uranium deposits in Africa; uranium mineralization in the Karroo system of Zambia; metallogeny of radioactive raw materials of Madagascar; geology of the uranium occurrence in the Bungua area, Siavonga District, Zambia; uranium occurrences in the gneisses of the Dahomeyan formation of northern Togo; uranium occurrence in the Katanga system of north-western Zambia; uranium deposits in the region of Franceville (Gabon); uranium deposits in Zaire; airborne gamma-ray spectrometric surveys in Zambia; uranium exploration activities in Libyan Arab Jamahiriya; uranium epochs; unconformity uranium deposits; sandstone-type uranium deposits; and distribution of uranium and possibilities of its concentration in sedimentary phosphates.

EXPLORATION

REFER ALSO TO CITATION(S) 20096

20097 (DP-MS—79-88) **Use of NURE HSSR data for resource studies of rare earth minerals.** Price, V. Jr.; Ferguson, R.B.; Griffin, V.S. Jr. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.; Clemson Univ., SC (USA). Dept. of Chemistry and Geology). 1980. Contract EY-76-C-09-0001. 12p. (CONF-800346—1). Dep. NTIS, PC A02/MF A01.

From Southeastern Section of the Geological Society of America conference; Birmingham, AL, USA (27 Mar 1980).

SRL is conducting geochemical surveys in 37 eastern and western states of USA. The sampling pattern used is described. The utility of the NURE data for outlining areas containing rare-earth minerals in streams sediments is illustrated using monazite in the southeastern US (TN, NC, SC, and GA) as an example. 4 figures. (DLC)

20098 (GJBX—21(80)) **National Uranium Resource Evaluation Program. Hydrogeochemical and Stream Sediment Reconnaissance Basic Data Reports Computer Program Requests Manual.** (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 31 Jan 1980. Contract EY-76-C-13-1664. 127p. Dep. NTIS, PC A07/MF A01.

This manual is intended to aid those who are unfamiliar with ordering computer output for verification and preparation of Uranium Resource Evaluation (URE) Project reconnaissance basic data reports. The manual is also intended to help standardize the procedures for preparing the reports. Each section describes a program or group of related programs. The sections are divided into three parts: Purpose, Request Forms, and Requested Information.

20099 (GJBX—31(80)) **Brushy Basin drilling project, Cedar Mountain, Emergy County, Utah.** Kiloh, K.D.; McNeil, M.; Vizcaino, H. (Bendix Field Engineering Corp., Grand Junction, CO (USA)). Mar 1980. Contract EY-76-C-13-1664. 53p. Dep. NTIS, PC A04/MF A01.

A 12-hole drilling program was conducted on the northwestern flank of the San Rafael swell of eastern Utah to obtain subsurface geologic data to evaluate the uranium resource potential of the Brushy Basin Member of the Morrison Formation (Jurassic). In the Cedar Mountain-Castle Valley area, the Brushy Basin Member consists primarily of tuffaceous and carbonaceous mudstones. Known uranium mineralization is thin, spotty, very low grade, and occurs in small lenticular pods. Four of the 12 drill holes penetrated thin intervals of intermediate-grade uranium mineralization in the Brushy Basin. The study confirmed that the unit does not contain significant deposits of intermediate-grade uranium.

20100 (GJBX—33(80)) **Report on the mineral resource investigations in six areas of central and northeastern Alaska.** Stablein, N.K. (Bendix Field Engineering Corp., Grand Junction, CO (USA)). Feb

1980. Contract EY-76-C-13-1664. 328p. Dep. NTIS, PC A15/MF A01.

This report contains multielement (uranium and 42 others) analyses of 2,000 rock and sediment samples collected by US Bureau of Mines personnel in six project areas in central and northeastern Alaska. Analyses of the samples were performed by the Los Alamos Scientific Laboratory, with funding provided by the US Department of Energy as a part of the National Uranium Resource Evaluation (NURE) program. The data will be useful in assessing uranium and other mineral resource potential in the areas sampled. No data evaluation is presented in this report.

20101 (GJBX—50(80)) **Engineering report on the Great Divide Basin Drilling Project, Sweetwater County, Wyoming.** Ferrell, P.; Vizcaino, H. (Bendix Field Engineering Corp., Grand Junction, CO (USA)). Apr 1980. Contract EY-76-C-13-1664. 11p. Dep. NTIS, PC A02/MF A01.

This report presents engineering details, logistics, and individual borehole histories of six holes drilled in the Great Divide Basin Sweetwater County, Wyoming. The objective was to test the uranium potential of the Battle Spring Formation (Tertiary) where the unit contains uraniferous carbonaceous shales and mudstones. Drilling began September 6, 1979, and was completed September 13, 1979.

20102 (GJBX—59(80)) **Aerial radiometric and magnetic reconnaissance survey of south-central Colorado Trinidad Quadrangle. Volume 1. Instrumentation and methods.** (Texas Instruments, Inc., Dallas (USA)). Jan 1980. Contract EY-76-C-13-1664. 59p. Dep. NTIS, PC A04/MF A01.

Instrumentation and methods described were used for a Department of Energy (DOE) sponsored high-sensitivity, aerial gamma-ray spectrometer and magnetometer survey of the Trinidad, Colorado, NTMS, 1:250,000-scale quadrangle. The survey was carried out by Texas Instruments Incorporated under Bendix Field Engineering Corporation Subcontract No. 79-263-L. Objective of the work was to define areas showing surface indications of a generally higher uranium content where detailed exploration for uranium would most likely be successful.

20103 (GJBX—68(80)) **Aerial radiometric and magnetic survey: Wilmington National Topographic Map, Delaware/Maryland/New Jersey/Pennsylvania.** (Geodata International, Inc., Dallas, TX (USA)). 1980. Contract EY-76-C-13-1664. 219p. Dep. NTIS, PC A$20.50/MF $9.05.

The results of analyses of the airborne gamma radiation and total magnetic field survey flown for the region identified as the Wilmington National Topographic Map NJ18-2 are presented. The airborne data gathered are reduced by ground computer facilities to yield profile plots of the basic uranium, thorium and potassium equivalent gamma radiation intensities, ratios of these intensities, aircraft altitude above the earth's surface, total gamma ray and earth's magnetic field intensity, correlated as a function of geologic units. The distribution of data within each geologic unit, for all surveyed map lines and tie lines, has been calculated and is included. Two sets of profiled data for each line are included, with one set displaying the above-cited data. The second set includes only flight line magnetic field, temperature, pressure, altitude data plus magnetic field data as measured at a base station. A general description of the area, including descriptions of the various geologic units and the corresponding airborne data, is included also.

20104 (GJBX—69(80)(Vol.1)) **Aerial gamma ray and magnetic survey: Nebraska/Texas Project, the Tyler, Texarkana, and Waco quadrangles of Texas, Oklahoma, Arkansas, and Louisiana. Final report.** (EG and G GeoMetrics, Sunnyvale, CA (USA)). Feb 1980. Contract EY-76-C-13-1664. 69p. Dep. NTIS, PC A04/MF A01.

During the months of September and October, 1979, EG and G geoMetrics collected 8866 line miles of high sensitivity airborne radiometric and magnetic data. Data were gathered primarily within the state of Texas, in three 1 x 2 degree NTMS quadrangles. This project is part of the Department of Energy's National Uranium Resource Evaluation Program. All radiometric and magnetic data were fully corrected and interpreted by geoMetrics and are presented as four Volumes (one Volume I and three Volume II's). The quadrangles are dominated by Cretaceous and Tertiary marine sediments. The cretaceous rocks are largely shallow marine sediments of biogenic origin, whereas the Tertiary sequence represents transgressing shelf and slope deposits. No uranium deposits are known in this area (Schnabel, 1955).

20105 (GJBX—69(80)(Vol.2)) **Aerial gamma ray and magnetic survey: Nebraska/Texas survey, Texarkana Quadrangle of Texas, Oklahoma, Arkansas, and Louisiana. Final report.** (EG and G GeoMetrics, Sunnyvale, CA (USA)). 1980. Contract EY-76-C-13-1664. 380p. Dep. NTIS, P $22.50/MF $4.55.

The Texarkana quadrangle of eastern Texas and portions of three adjacent states lies within the northern Gulf Coastal Province. The area contains portions of the Ouachita Tectonic Belt and the East Texas-Athens Embayment. The Mexia-Talco Fault Zone strikes roughly east-west through the center of the quadrangle. North of the fault zone Cretaceous platform deposits dominate, whereas Eocene neritic sediments cover most of the area south of the zone. Examination of available literature shows no known uranium deposits (or occurrences) within the quadrangle. One hundred fifty-nine groups of uranium samples were defined as anomalies and discussed briefly in this report. None were considered significant, and most appeared to be of cultural origin. Magnetic data in the quadrangle are dominantly low frequency/low amplitude wavelengths, which suggests that sources may be extremely deep.

20106 (GJBX—69(80)(Vol.2)TYLER) **Aerial gamma ray and magnetic survey: Nebraska/Texas survey, Tyler quadrangle of Texas and Louisiana. Final report.** (EG and G GeoMetrics, Sunnyvale, CA (USA)). Feb 1980. Contract EY-76-C-13-1664. 274p. Dep. NTIS, PC A$18.50/MF $5.00.

The Tyler quadrangle of eastern Texas and westernmost Louisiana lies within the northern Gulf Coastal Province. The area contains portions of the East Texas-Athens Embayment, and the Sabine Uplift which strikes NW through the NW corner of the area. Eocene neritic sediments are dominant, though Cretaceous platform deposits are exposed in the extreme NW corner. Available literature shows no known uranium deposits (or occurrences) within the quadrangle. One hundred thirty-six groups of uranium samples were defined as anomalous and discussed briefly in this report. None are considered significant. Most appear to be of cultural origin. Magnetic data in the quadrangle are dominantly low frequency/low amplitude wavelengths, which suggests that sources may be extremely deep.

20107 (GJBX—69(80)(Vol.2)WACO) **Aerial gamma ray and magnetic survey: Nebraska/Texas survey, Waco quadrangle of Texas.** (EG and G GeoMetrics, Sunnyvale, CA (USA)). Feb 1980. Contract EY-76-C-13-1664. 367p. Dep. NTIS, PC $22.50/MF $4.55.

The Waco quadrangle of eastern Texas lies within the northern Gulf Coastal Province. The area contains portions of the Ouachita Tectonic Belt, and the East Texas-Athens Embayment. The Mexia-Talco Fault Zone strikes NNW through the center of the area. West of the fault zone, Eocene neritic sediments are dominant, whereas Cretaceous platform deposits cover most of the area west of the zone. Examination of available literature shows no known uranium deposits (or occurrences) within the quadrangle. One hundred forty-four groups of uranium samples were defined as anomalous and discussed briefly in this report. None are considered significant. Most appear to be of cultural origin. Magnetic data in the quadrangle are dominantly low frequency/low amplitude wavelengths, which suggest that sources may be extremely deep.

20108 (GJBX—70(80)(Vol.1)) **Airborne gamma-ray spectrometer and magnetometer survey: Birmingham Quadrangle (Alabama), Gadsden Quadrangle (Alabama, Tennessee). Final report.** (High Life Helicopters, Inc., Puyallup, WA (USA); QEB, Inc., Hayward, CA (USA)). 1979. Contract EY-76-C-13-1664. 81p. Dep. NTIS, PCE 27.50/MF $20.75.

A combined airborne radiometric and magnetic survey was performed over the Birmingham and Gadsden 1:250,000 NTMS Quadrangles, Alabama. Data were collected with a helicopter utilizing a gamma-ray spectrometer, with a large crystal volume, and a high sensitivity proton precession magnetometer. Data processing was principally directed to correcting for effects introduced by cosmic radiation, atmospheric radon, altitude dependence, and the aircraft. The corrected data were statistically treated to produce anomaly maps based on the radiometric response of individual geologic units. These maps were interpreted to produce a uranium anomaly interpretation map. This volume contains a description of the systems; a discussion of the calibration of the data collecting systems, the data processing, the data display format; the interpretation rationale, and the interpretation methodology.

20109 (GJBX—70(80)(Vol.2)) **Airborne gamma-ray spectrometer and magnetometer survey: Gadsden quadrangle, Alabama/Tennessee. Final report.** (High Life Helicopters, Inc., Puyallup, WA (USA); QEB, Inc., Hayward, CA (USA)). Sep 1979. Contract EY-76-C-13-1664. 752p. Dep. NTIS, PC A99/MF A01.

A total of 68 uranium anomalies meet the minimum statistical requirements as defined in Volume I, and a cursory culling process based on observed cultural effects. These anomalies are depicted on the Uranium Anomaly Interpretation map as well as being summarized in tabular form. This map also includes location of major cultural features and the results of the magnetic interpretation. Potassium, uranium, thorium and Magnetic Pseudo-contour maps are presented at reduced scale in Appendix E. Stacked profiles depicting geologic strip maps along each flight line together with various sensor data are included as Appendix F. Geologic units were based on the mapped geologic unit description and are presented in Appendix C. The anomalies are distributed throughout the quadrangle, singly and in clusters. Surficial geology of the Gadsden Quadrangle is relatively passive. Faulting or intense folding occurs only in the

Valley and Ridge province. However, basement conditions are much different. Extensive faulting, inferred from magnetic discontinuities, offsets and juxtaposes a number of discrete deep magnetic bodies, generally represented by moderate-amplitude, long-wavelength signatures. Often superimposed on these long-wavelengths are high-amplitude, short wavelength features - perhaps representing intrusive bodies in the deeper bodies. The Valley and Ridge province in the southeastern part of the quadrangle is characterized by low amplitude, long-wavelength contours. A large through-going magnetic discontinuity demarcates a province boundary. Many of the smaller discontinuities are subparallel to the northeast structural trend. However, many east-west features are also mapped as boundaries of discrete bodies.

20110 (GJBX—71(80)(Vol.1)) **Aerial gamma ray and magnetic survey: Idaho Project, Ogden and Salt Lake City quadrangles of Utah and Wyoming. Final report.** (EG and G GeoMetrics, Sunnyvale, CA (USA)). Dec 1979. Contract EY-76-C-13-1664. 67p. Dep. NTIS, PC E$16.50/MF E$3.65.

During the months of September and October 1979, EG and G geoMetrics collected 6050 line miles of high sensitivity airborne radiometric and magnetic data in Utah and adjoining portions of Wyoming over two 1° x 2° NTMS quadrangles (Ogden and Salt Lake City) as part of the Department of Energy's National Uranium Resource Evaluation Program. All radiometric and magnetic data were fully corrected and interpreted by geoMetrics and are presented as three volumes (one Volume I and two Volume II's). Paleozoic and Precambrian rocks dominate the surface of the mountainous areas (the Wasatch-Bear River Belt and the Uinta Mountains) of the Central Rocky Mountain Province. Cretaceous and Tertiary sediments cover the basin areas of the Colorado Plateau and Wyoming Basins Provinces. Quaternary sediments cover most of the lower lying areas west of the Rockies in the Basin-Range Province. A prominent belt of reverse thrust faults strikes N-S through the Wasatch Range of Sevier age. Later normal faults (also oriented N-S) are superimposed on the older belt which offsets Quaternary age sediments. There are no known uranium occurrences in either quadrangles, but outcrops of Permian Phosphorite beds may contain some economic concentrations of uranium similar to nearby known deposits.

20111 (GJBX—71(80)(Vol.2)(OGDEN)) **Aerial gamma ray and magnetic survey: Idaho Project, Ogden Quadrangle, Utah and Wyoming. Final report.** (EG and G GeoMetrics, Sunnyvale, CA (USA)). Dec 1979. Contract EY-76-C-13-1664. 414p. Dep. NTIS, PC A18/MF A01.

The Ogden quadrangle in northeastern Utah and southe western Wyoming contains portions of the Green River Basin, the Wasatch-Teton Line, and the Sevier overthrust belt. A small percentage of the quadrangle along the western edge lies within the Basin-Range Province. Tertiary nonmarine sediments dominate the surface of the quadrangle, grading into tightly folded Mesozoic and Paleozoic sediments and Precambrian crystalline rock in the uplifted regions of the west. Laramide thrust faults and younger normal faults have contributed significantly to the present set of exposures and the topography of the area. Magnetic data apparently show dominantly deep sources except in the Wasatch-Bear River Mountain chains where crystalline basement is partially exposed. The Ogden quadrangle has been unproductive in terms of uranium mining. No claims were found by examination of known literature sources. A total of 255 anomalies are valid according to the criteria set forth in Volume I. The anomalies are scattered throughout the quadrangle. One well-defined group has peak concentrations in the range of 10.0 ppm eU or greater. Some anomalies in this group show obvious signs of recent surveying and/or development on flight recovery film.

20112 (GJBX—71(80)(Vol.2)(SL)) **Aerial gamma ray and magnetic survey: Idaho project, Salt Lake City quadrangle of Utah. Final report.** (EG and G GeoMetrics, Sunnyvale, CA (USA)). Mar 1980. Contract EY-76-C-13-1664. 426p. Dep. NTIS, PC A19/MF A01.

The Salt Lake City quadrangle in northeastern Utah contains portions of the Uinta Uplift, Uinta and Green River Basins, the Sevier Overthrust Belt, and the Basin-Range Province. Tertiary sediments dominate in the basins, Quaternary surface deposits and Precambrian sedimentary rocks are prevalent in the Uinta Uplift. Portions of the Uinta Uplift, and most of the Wasatch Mountains contain exposures of a tightly folded sequence of Mesozoic and Paleozoic Rocks. Laramide thrust faults and younger normal faults have contributed significantly to the recent topography of the area. Magnetic data apparently show dominantly deep sources, except in the Wasatch/Western Uinta area, where Tertiary intrusive bodies are exposed. The Salt Lake City quadrangle has apparently been relatively unproductive in terms of uranium mining. No claims were found by examination of known literature sources. A total of 199 anomalies are valid according to the criteria set forth in Volume I. The anomalies are scattered throughout the quadrangle. Other than a single anomaly of 46.8 ppM eU over an old AEC dump, none have peak count rates over 7.1 ppM eU.

20113 (K/UR—21(Pt.4)) **National Uranium Resource Evaluation Program. Hydrogeochemical and Stream Sediment Reconnaissance Program in Central United States. Semiannual progress report, October 31, 1979-March 31, 1980.** (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 7 Apr 1980. Contract W-7405-ENG-26. 20p. Dep. NTIS, PC A02/MF A01.

Union Carbide Corporation, Nuclear Division (UCC-ND), under contract with the US DOE, is continuing to conduct its survey of 154 National Topographic Map Series (NTMS) 1° x 2° quadrangles which cover approximately 2,500,000 km² (1,000,000 mi²) of the Central United States. A progress report on quadrangle sampling, analyses, and reporting by the Uranium Resource Evaluation (URE) Project is presented. Results of these analyses are also discussed in this report.

FEED PROCESSING

REFER ALSO TO CITATION(S) 20053, 20949

GASEOUS DIFFUSION

REFER ALSO TO CITATION(S) 20194, 20199, 20824

FUELS PRODUCTION AND PROPERTIES

REFER ALSO TO CITATION(S) 20206

20114 (CONF-791103—79) **Oak Ridge National Laboratory Ceramic Fuels Alpha Facility.** Williams, L.C.; Bomar, E.S. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 19p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

Advanced reactor fuels development within the Metals and Ceramics Division of the Oak Ridge National Laboratory requires working with Pu and ^{233}U compounds. Since these compounds are radiotoxic, all fuel development work must be performed in specially designed enclosures within laboratories that have been specifically designed for this purpose. The Ceramic Fuels Alpha Facility (CFAF) consists of 3 alpha containment laboratories housing 31 glove boxes and an air-lock change room. This paper presents an overview of the CFAF, including its operation and a general description of the equipment.

20115 (DPSTSA—200-5) **Safety analysis report for the $^{238}PuO_2$ fuel form facility.** Angerman, C.L.; Bickford, D.F.; Gould, T.H. Jr.; Smith, P.K. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Aug 1977. Contract EY-76-C-09-0001. 200p. Dep. NTIS, PC A09/MF A01.

The Plutonium Fuel Form (PuFF) Facility has been constructed at the Savannah River Plant to manufacture 30 to 60 kg/yr of ^{238}Pu fuel forms for space power applications. This facility is located in the existing Building 235-F near the geographical center of the Savannah River Plant (SRP) site. Pilot production is scheduled to begin in July 1977, with full-scale production in April 1978. The process line of the facility consists of nine separate, interconnected shielded cells; five shielded wing cabinets or glove boxes; three hoods; and contained auxiliary equipment. These process enclosures will be, for the most part, under an atmosphere of recirculating inert gas. The products of the facility will be dense fuel forms manufactured from PuO_2 powder with a nominal isotopic composition of 80% ^{238}Pu-20% ^{239}Pu. This powder, made from calcined oxalate, has been produced safely at a rate of about 20 kg ^{238}Pu/yr in the H-Area B-Line in Building 221-H for approximately ten years. This report describes design objectives, nature of operations, potential hazards and limiting factors, facility response to postulated accidents and failures, and environmental effects. The results of the analyses described in this report indicate that the facility has the capacity to prevent or sufficiently reduce accidents that represent potential risks to health and safety. The safety analysis in conjunction with process requirements provides the bases for Technical Standards for operation. The analysis also documents the degree of conformance of the facility design with the General Design Criteria - Plutonium Facilities and the Environmental Statement.

20116 **Remote nuclear green pellet processing apparatus.** Cellier, F. (to Westinghouse Electric Corp.). US Patent 4,174,938. 20 Nov 1979. Filed date 26 Aug 1977. 8p.

An automated system for manufacturing nuclear fuel pellets for use in nuclear fuel elements of nuclear power reactors is disclosed. The system comprises process components arranged vertically but not directly under each other within a single enclosure. The vertical-lateral arrangement provides for gravity flow of the product from one component to the next and for vertical removal of each component without interference with the other components. The

single enclosure eliminates time consuming transfer between separate enclosures of each component while providing three-sided access to the component through glove ports.

SPENT FUELS REPROCESSING

REFER ALSO TO CITATION(S) 20114, 20131, 20162, 20204, 20208, 20209, 20219

20117 (CONF-800610—2) **Removal of actinides from nuclear fuel reprocessing wastes using an organophosphorous extractant.** Chamberlain, D.B.; Maxey, H.R.; McIsaac, L.D.; McManus, G.J. (Exxon Nuclear Idaho Co., Inc., Idaho Falls (USA)). Jan 1980. Contract EY-76-C-07-1570. 29p. Dep. NTIS, PC A03/MF A01.

From American Institute of Chemical Engineering conference; Philadelphia, PA, USA (8 Jun 1980).

By removing actinides from nuclear fuel reprocessing wastes, long term waste storage hazards are reduced. A solvent extraction process to remove actinides has been demonstrated in miniature mixer-settlers and in simulated columns using actinide feeds. Nonradioactive pilot plant results have established the feasibility of using pulse columns for the process.

20118 (DP-MS—79-99) **Computer-controlled on-line gamma analysis for krypton-85.** Canuette, R.P. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Mar 1980. Contract EY-76-C-09-0001. 24p. (CONF-800303—15). Dep. NTIS, PC A02/MF A01.

From 179. national meeting of the American Chemical Society; Houston, TX, USA (23 Mar 1980).

^{85}Kr will be evolved from spent nuclear fuel during both the voloxidation and dissolution processes, so a reliable method for on-line analysis of ^{85}Kr in the off-gas system is needed. Tritium, ^{14}C, and ^{129}I were trapped, and the activity of ^{85}Kr was then measured using a Li-drifted Ge detector. Equipment used to carry out this analysis is described; the PET computer is used. The ^{85}Kr evolution rate was correlated with the fuel dissolution rate; the close correlation permits one to monitor the fuel dissolution process. 11 figures. (DLC)

20119 (LA—8272-PR) **Fission product release. Progress report, October 1-December 31, 1979.** Norris, A.E. (comp.). (Los Alamos Scientific Lab., NM (USA)). Mar 1980. Contract W-7405-ENG-36. 9p. Dep. NTIS, PC A02/MF A01.

The set of experiments, undertaken to compare the effects of leaching spent fuel wafers in deionized water at pH 4 under oxidizing and under reducing conditions, was concluded this quarter. Analyses of the leachant solutions still are in progress. A new set of leaching experiments under oxidizing and reducing conditions was begun at pH 8, a pH value likely to be encountered in the ground waters near a nuclear waste repository. Additional experiments were performed to determine whether reducing conditions could be obtained that resulted in less dissolution of UO_2 than has been observed in previous measurements. Addition of a palladium-black catalyst to an ongoing UO_2 dissolution experiment in which hydrogen gas is the reducing agent dramatically lowered the uranium concentration in solution. Work is continuing to determine whether the uranium decrease is caused by a change in the solution or by provision of additional uranium sorption sites. Use of Fe^{2+} $(o\text{-phenanthroline})_3$ as a reductant in an experiment with sintered UO_2 yielded uranium concentrations in deionized water that were about one-tenth the values obtained in the similar spent-fuel leaching experiments.

20120 (ORNL/TM—5683) **High-temperature oxidation of graphite rods with temperature control by combustion gas recycle.** Canon, R.M. (Oak Ridge National Lab., TN (USA)). Apr 1980. Contract W-7405-ENG-26. 26p. Dep. NTIS, PC A03/MF A01.

The combustion of graphite (fuel blocks) is of fundamental importance in the fuel reprocessing scheme for the High-Temperature Gas-Cooled Reactor (HTGR). A study was made to evaluate a chunk-type burner for possible application in this reprocessing step. The combustion gases were recycled to allow operation at higher burn rates without an increase in graphite temperature. Graphite rods of two diameters were oxidized with makeup oxygen and recycled stack gases at various gas flow rates in an insulated reactor. Results of this study indicate a strong dependence of oxygen transfer on gas flow rate with little effect resulting from changes in graphite temperature. High carbon monoxide concentrations in the exit gas were not a problem except at oxygen concentrations below ~ 5%. Stable operation of a recycle controlled burner was achieved, avoiding the temperature excursions common in previous graphite burners.

20121 (PNL—3166(Pt.2)) **Cladding hull decontamination and densification process. Part 2. Densification by inductoslag melting.** Nelson, R.G.; Montgomery, D.R. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Apr 1980. Contract EY-76-C-06-1830. 52p. Dep. NTIS, PC A04/MF A01.

The Inductoslag melting process was developed to densify Zircaloy-4 cladding hulls. It is a cold crucible process that uses induction heating, a segmented water-cooled copper crucible, and a calcium fluoride flux. Metal and flux are fed into the furnace through the crucible, located at the top of the furnace, and the finished ingot is withdrawn from the bottom of the furnace. Melting rates of 40 to 50 kg/h are achieved, using 100 to 110 kW at an average energy use of 2.5 kWh/kg. The quality of ingots produced from factory supplied cladding tubing is sufficient to satisfy nuclear grade standards. An ingot of Zircaloy-4, made from melted cladding tubing that had been autoclaved to near reactor exposure and then descaled by the hydrogen fluoride decontamination process prior to Inductoslag melting, did not meet nuclear grade standards because the hydrogen, nitrogen, and hardness levels were too high. Melting development work is described that could possibly be used to test the capability of the Inductoslag process to satisfactorily melt a variety and mix of materials from LWR reprocessing, decontamination, and storage options. Results of experiments are also presented that could be used to improve remote operation of the melting process.

TRANSPORT AND STORAGE

REFER ALSO TO CITATION(S) 20161, 20164, 20166, 20167, 20207, 20729, 21012, 21020

20122 (HEDL-SA—1890-FP) **Role of spent fuel characterization in the development of safe repositories.** Fish, R.L.; Davis, R.B.; Cantley, D.A. (Hanford Engineering Development Lab., Richland, WA (USA)). Aug 1979. Contract EY-76-C-14-2170. 25p. (CONF-791033—8). Dep. NTIS, PC A02/MF A01.

From 1. annual ONWI information meeting; Columbus, OH, USA (30 Oct 1979).

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Objective is to understand the spent fuel performance. In order to do this, we must quantify the spent fuel characteristics at various time intervals during specific field and laboratory tests. This spent fuel characterization is used to identify and describe mathematically the degradation modes experienced during the tests. Incorporation of these descriptions into the more comprehensive spent fuel performance prediction model will aid in the overall licensing of repositories for permanent disposal of the spent fuel waste form.

20123 (HEDL-SA—1891-FP) **Spent fuel: prediction model development.** Almassy, M.Y.; Bosi, D.M.; Cantley, D.A. (Hanford Engineering Development Lab., Richland, WA (USA)). Jul 1979. Contract EY-76-C-14-2170. 29p. (CONF-791033—6). Dep. NTIS, PC A03/MF A01.

From 1. annual ONWI information meeting; Columbus, OH, USA (30 Oct 1979).

Portions of document are illegible.

The need for spent fuel disposal performance modeling stems from a requirement to assess the risks involved with deep geologic disposal of spent fuel, and to support licensing and public acceptance of spent fuel repositories. Through the balanced program of analysis, diagnostic testing, and disposal demonstration tests, highlighted in this presentation, the goal of defining risks and of quantifying fuel performance during long-term disposal can be attained.

20124 (ONWI—39(Vol.1)) **Assessment of LWR spent fuel disposal options. Volume 1. Summary and conclusions.** (Bechtel National, Inc., San Francisco, CA (USA)). Jul 1979. Contract EY-76-C-06-1830. 36p. Dep. NTIS, PC A03/MF A01.

The study identifies several spent fuel waste forms as well as the high level waste (HLW) and other waste forms from fuel reprocessing, defines facility and system design features to handle, transport, process, encapsulate, and dispose of these spent fuel and waste forms, and provides a comparative assessment of each of the spent fuel/waste alternatives with respect to technical feasibility, safeguards, criticality, radiological impact, retrievability, and economics. This volume provides the reader with a general overview of the study, coupled with the specific conclusions developed from the comparative assessments of the study cases and study variations.

20125 (RHO-SA—136) **Spent fuel Receiving and Packaging Facility conceptual design.** Henry, K.H.; Kurzeka, W.J. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Oct 1979. Contract EY-77-C-06-1030. 8p. (CONF-791033—5). Dep. NTIS, PC A02/MF A01.

From 1. annual ONWI information meeting; Columbus, OH, USA (30 Oct 1979).

The Spent Unreprocessed Fuel (SURF) Program was initiated to provide facilities to receive and package the spent fuel, and to provide interim storage in surface structures with a passive cooling mode. This paper describes the conceptual design of the Receiving

and Packaging Facility (RPF) module for that program. The design is also applicable to packaging spent fuel for geologic disposal.

20126 (RHO-SA—141) **Standardized experimental package for spent fuel.** Davis, J.M.; Smith, R.E. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Oct 1979. Contract EY-77-C-06-1030. 7p. (CONF-791033—4). Dep. NTIS, PC A02/MF A01.

From 1. annual ONWI information meeting; Columbus, OH, USA (30 Oct 1979).

Design requirements are set forth for a package for geologic disposal of spent fuel. Conceptual design has been completed and preliminary drop tests conducted. (DLC)

20127 (SAND—80-0037C) **Program to assess the effects of extraordinary environments on radioactive material shipping systems.** Sandoval, R.P.; Reese, R.T. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 12p. (CONF-800334—6). Dep. NTIS, PC A02/MF A01.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

The highlights of the Transportation System Safety Evaluation (TSSE) Program at Sandia National Laboratories are reviewed and the origins of the program and the relationships to other programs addressing safety concerns are outlined. The areas of current activity in the assessment of possible effects an intentional act or extreme environment could have on nuclear material shipping systems are described. Early information has been obtained on the formation of aerosols, and a significant body of experimentally determined source term data will be available for radiological consequence evaluations. (DC)

20128 (SAND—80-0784) **Program strategy document for the nuclear materials. Transportation Technology Center (FY 80).** Jefferson, R.M. (ed.). (Sandia Labs., Albuquerque, NM (USA)). Apr 1980. Contract FY-76-C-04-0789. 260p. (TTC—0080). Dep. NTIS, PC A12/MF A01.

The TTC's program is divided into four principal areas, Technology and Information Center, Systems Development, Technology, and Institutional Issues. These areas are broken into activities, elements, and subelements which are delineated in this document.

20129 (UCRL—83976) **Test storage of spent reactor fuel in the Climax granite at the Nevada Test Site.** Ramspott, L.D.; Ballou, L.B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 Feb 1980. Contract W-7405-ENG-48. 17p. (CONF-800313—5). Dep. NTIS, PC A02/MF A01.

From Waste management conference; Tucson, AZ, USA (10 Mar 1980).

A test of retrievable dry geologic storage of spent fuel assemblies from an operating commercial nuclear reactor is underway at the Nevada Test Site. This generic test is located 420 m below the surface in the Climax granitic stock. Eleven canisters of spent fuel approximately 2.3 years out of reactor core (about 2 kW/canister thermal output) will be emplaced in a storage drift along with 6 electrical simulator canisters and their effects will be compared. Two adjacent drifts will contain electrical heaters, which will be operated to simulate within the test array the thermal field of a large repository. The test objectives, technical concepts and rationale, and details of the test are stated and discussed.

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 20158

20130 (CONF-791112—50) **Characterization of impact fracture of brittle solid-waste forms.** Mecham, W.J.; Jardine, L.J.; Pelto, R.H.; Steindler, M.J. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 13p. Dep. NTIS, PC A02/MF A01.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1979).

This paper presents a methodology for analyzing particle size distributions obtained in impact testing of brittle waste-form materials. The methodology includes (a) a linear two-parameter lognormal correlation of the weight fraction less than any given size, (b) a mathematical function of the two lognormal parameters to determine the total surface area in terms of a dimensionless shape factor, and (c) a surface-energy constant to predict the anticipated increase of surface area from the known energy absorbed in the impact of the brittle material. Preliminary measurements were made on impacted simulated glass specimens. The analysis is used as an example of the methodology. These results are also compared with reanalyzed impact test data reported by others.

20131 (CONF-800444—1) **Overall assessment of actinide partitioning and transmutation for waste management purposes.** Blomeke, J.O.; Croff, A.G.; Finney, B.C.; Tedder, D.W. (Oak Ridge National Lab., TN (USA); Georgia Inst. of Tech., Atlanta (USA)). 1980. Contract W-7405-ENG-26. 21p. Dep. NTIS, PC A02/MF A01.

From 2. technical meeting on the nuclear transmutation of actinides; Ispra, Italy (21 Apr 1980).

A program to establish the technical feasibility and incentives for partitioning (i.e., recovering) actinides from fuel cycle wastes and then transmuting them in power reactors to shorter-lived or stable nuclides has recently been concluded at the Oak Ridge National Laboratory. The feasibility was established by experimentally investigating the reduction that can be practicably achieved in the actinide content of the wastes sent to a geologic repository, and the incentives for implementing this concept were defined by determining the incremental costs, risks, and benefits. Eight US Department of Energy laboratories and three private companies participated in the program over its 3-year duration. A reference fuel cycle was chosen based on a self-generated plutonium recycle PWR, and chemical flowsheets based on solvent extraction and ion-exchange techniques were generated that have the potential to reduce actinides in fuel fabrication and reprocessing plant wastes to less than 0.25% of those in the spent fuel. Waste treatment facilities utilizing these flowsheets were designed conceptually, and their costs were estimated. Finally, the short-term (contemporary) risks from fuel cycle operations and long-term (future) risks from deep geologic disposal of the wastes were estimated for cases with and without partitioning and transmutation. It was concluded that, while both actinide partitioning from wastes and transmutation in power reactors appear to be feasible using currently identified and studied technology, implementation of this concept cannot be justified because of the small long-term benefits and substantially increased costs of the concept.

20132 (CONF-800447—1) **Biological denitrification of high-nitrates wastes generated in the nuclear industry.** Francis, C.W. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 21p. Dep. NTIS, PC A02/MF A01.

From Water Research Centre and University of Manchester Institute of Science and Technology conference; Manchester, UK (15 Apr 1980).

Biological denitrification appears to be one of the most effective methods to remove nitrates from wastewater streams (Christenson and Harremoes, 1975). However, most of the research and development work has been centered on removal of nitrates from sewage or agricultural drainage waters, nitrate nitrogen concentration usually less than 50 g/m^3. Work was initiated at Oak Ridge National Laboratory (ORNL) in 1974 to test the use of biological nitrification in the removal of high concentrations of nitrate (in excess of 1.0 kg NO_3-N/m^3) from uranium purification waste streams. Since then, a full-scale treatment facility, a stirred reactor, has been installed at the Y-12 plant; and a pilot-plant, using a fluidized bed, has been proposed at Portsmouth Gaseous Diffusion Plant. The objective of this manuscript is to present some applied microbiological research relating to possible constraints in biologically denitrifying certain waste streams in the nuclear industry and comparing the effectiveness of denitrification of these waste streams in three bench scale reactors, (1) a continuous flow-stirred reactor, (2) stirred bed rector, and (3) a fluidized bed reactor.

20133 (CONF-800607—27) **Department of Energy low-level waste management strategy.** (EG and G Idaho, Inc., Idaho Falls (USA)). 1980. Contract EY-76-C-07-1570. 2p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society annual meeting; Las Vegas, NV, USA (8 Jun 1980).

The DOE strategy recognizes that public perception of low-level waste management practices is not positive. Actions are included that are aimed at opening the system to the public. A better informed public will be able to better assess the performance of the low-level waste management system.

20134 (DOE/NE—0008) **Nuclear Waste Management Program summary document, FY 1981.** (Department of Energy, Washington, DC (USA)). Mar 1980. 283p. Dep. NTIS, PC A13/MF A01.

The Nuclear Waste Management Program Summary Document outlines the operational and research and development (R and D) activities of the Office of Nuclear Waste Management (NEW) under the Assistant Secretary for Nuclear Energy, US Department of Energy (DOE). This document focuses on the current and planned activities in waste management for FY 1981. This Program Summary Document (PSD) was prepared in order to explain the Federal nuclear waste management and spent fuel storage programs to Congress and its committees and to interested members of the public, the private sector, and the research community. The national energy policy as it applies to waste management and spent fuel storage is presented first. The program strategy, structure, budget, management approach, and public participation programs are then identified. The next section describes program activities and outlines their status. Finally, the applicability of departmental policies to NEW programs is summarized, including field and regional activi-

ties, commercialization plans, and environmental and socioeconomic implications of waste management activities, and international programs. This Nuclear Waste Management Program Summary Document is meant to serve as a guide to the progress of R and D and other energy technology programs in radioactive waste management. The R and D objective is to provide the Nation with acceptable solutions to short- and long-term management problems for all forms of radioactive waste and spent fuel.

20135 (ONWI—87) **Consultation and concurrence: workshop proceedings, September 23-26, 1979, the Orcas meeting, Eastsound, Washington.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Jan 1980. Contract EY-76-C-06-1830. 159p. Dep. NTIS, PC A08/MF A01.

Purpose of the workshop was to probe the concepts of consultation and concurrence and to address issues in establishing and maintaining an effective state-federal process in nuclear waste management. The workshop was a gathering of some 50 people from industry, the environmental movement, local government, executive and legislative branches of state government, US Congressional staffs, the US Department of Energy, Nuclear Regulatory Commission, ONWI, university social science departments, and other research institutions. The workshop consisted of general sessions at which ten papers covering various aspects of consultation and concurrence were presented and of working groups which further explored issues raised by the papers. This report presents a general summary of discussions, the text of a background paper prepared for the workshop, the presented papers, and individual comments by several participants.

20136 (PB—296947) **Low-level radioactive waste management.** Watson, J.E. (ed.). (Environmental Protection Agency, Washington, DC (USA). Office of Radiation Programs). May 1979. 547p. (EPA—520/3-79-002; CONF-790209—). NTIS, PC A99/MF A01.

From 12. Health Physics Society midyear topical symposium; Williamsburg, VA, USA (12 Feb 1979).

Portions of document are illegible.

This publication contains the proceedings of the Twelfth Mid-year Topical Symposium of the Health Physics Society on Low-Level Radioactive Waste Management held in Williamsburg, Virginia, February 11-15, 1979. There are fifty-seven papers included covering such topics on radioactive waste management as (1) the origin, (2) handling and transportation, (3) disposal operations and alternatives (4) regulatory aspects, (5) environmental, and (6) public health aspects. Separate abstracts are prepared for individual papers.

20137 (PNL—3254) **Materials Characterization Center program plan.** Nelson, R.D.; Ross, W.A.; Hill, O.F.; Mendel, J.E.; Merz, M.D.; Turcotte, R.P. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Mar 1980. Contract EY-76-C-06-1830. 82p. Dep. NTIS, PC A05/MF A01.

The Materials Characterization Center (MCC) has been established at Pacific Northwest Laboratory as part of the Materials Characterization Organization for providing an authoritative, referenceable basis for establishing nuclear waste material properties and test methods. The MCC will provide a data base that will include information on the components of the waste emplacement package - the spent fuel or processed waste form and the engineered barriers - and their interaction with each other and as affected by the environment. The MCC will plan materials testing, develop and document procedures, collect and analyze existing materials data, and conduct tests as necessary.

20138 (RHO-SA—148) **Use of a decommissioning cost/risk/benefit analysis to identify beneficial design features.** Sexton, R.A. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). 1980. Contract EY-77-C-06-1030. 6p. (CONF-800359—1). Dep. NTIS, PC A02/MF A01.

From NEA specialist meeting on decommissioning requirements in the design of nuclear facilities; Paris, France (17 Mar 1980).

A Cost/Risk/Benefit Analysis on the future decommissioning of the Hanford Z-Plant, a plutonium conversion and fabrication facility in the United States, was recently completed. The analysis has been used to identify decommissioning tasks high in cost of occupational radiation exposure. Recommendations for future design considerations have been made. They include ways of easing glove box removal, reducing piping removal requirements, and simplifying decontamination of structural surfaces.

20139 (UCRL—15214) **Procedures for aggregating citizen preferences in the context of the nuclear waste management problem. Final report.** Brock, H.W.; Sauer, G.L. (SRI International, Menlo Park, CA (USA)). Oct 1978. Contract W-7405-ENG-48. 73p. Dep. NTIS, PC A04/MF A01.

The purpose of the present paper is to provide an introduction to the theory of social choice and related disciplines, and to relate this theory to the concrete problem of nuclear waste management. In Section I of this report, an overview of the problem is provided. In Section II, two candidate preference aggregation procedures that can be used to identify a socially optimal waste management policy are identified. In Section III, a somewhat lengthy defense of the use of these two aggregation procedures is presented. Each is shown to be compatible with four intuitively appealing criteria of collective decision-making. In Section IV the application of one of the procedures to the evaluation of waste management alternatives is discussed. In Section V the problem of inferring evaluation parameters from expert and laypersons' judgments is addressed.

WASTE PROCESSING

REFER ALSO TO CITATION(S) 20117, 20134, 20647

20140 (CONF-791112—57) **Development and characterization of cermet forms for radioactive waste.** Aaron, W.S.; Quinby, T.C.; Kobisk, E.H. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 8p. Dep. NTIS, PC A02/MF A01.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1979).

Cermets designed to isolate high-level wastes in a solid form are a composite consisting of various ceramic phase particles uniformly dispersed in and microencapsulated by an iron-nickel base alloy matrix. The metal matrix provides this waste form with many advantageous features including excellent thermal conductivity and mechanical strength. These cermets are formed by first dissolving the waste in molten urea, precipitating and calcining all the constituents, compacting the calcine, and sintering and reduction to form the final product. The exact formulation of cermets through additions to the waste is designed to fix most of the fission products in stable, leach resistant ceramic phases which are subsequently microencapsulated by an alloy matrix. The alloy matrix, which is derived primarily from the waste itself and includes the reducible fission and activation products from the waste, can be compositionally adjusted through additions to optimize its corrosion resistance under conditions existing in various disposal environments. The processes by which cermets are formed include several new and unique materials preparation options that are being developed to permit engineering scale-up and to be compatible with remote operations. Cermets formed by alternate processing methods are being characterized. Initially, cermet samples were prepared using a laboratory scale, batch process developed for the preparation of special ceramics having high compositional uniformity and excellent sinterability. The modification of this batch process to one suitable for scale-up and remote operation is the subject of this paper. Cermet characterization is also discussed.

20141 (DP—79-157-3) **Long-term high-level waste technology. Composite quarterly technical report, July-September 1979.** Cornman, W.R. (comp.). (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Mar 1980. Contract EY-76-C-09-0001. 74p. Dep. NTIS, PC A04/MF A01.

This report summarizes work performed at participating sites (RHO, ORNL, SRP, SRL, PNL, ANL, LLL, etc., to immobilize high-level radioactive wastes from the chemical reprocessing of nuclear reactor fuels. Progress is reported in the following areas: program management and support, waste preparation, waste fixation (in glass, concrete, ceramics, cermet, SYNROC, or metal), and engineered barriers. (DLC)

20142 (DP-MS—79-92) **Characterization of off-gases from a small-scale, joule-heated ceramic melter for nuclear waste vitrification.** Woolsey, G.B.; Wilhite, E.L. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1980. Contract EY-76-C-09-0001. 30p. (CONF-800460—1). Dep. NTIS, PC A03/MF A01.

From 82. annual American Ceramic Society meeting; Chicago, IL, USA (27 Apr 1980).

This paper confirmed with actual nuclear waste the thermodynamic predictions of the fate of some of the semivolatiles in off-gas. Ruthenium behaves erratically and it is postulated that it migrates as a finely divided solid, rather than as a volatile oxide. Provisions for handling these waste off-gasses will be incorporated in the design of facilities for vitrifying SRP waste.

20143 (EGG—2017) **SPI Project Criticality Task Force initial review and assessment.** McKinley, K.B.; Cannon, J.W.; Marsden, R.S.; Worle, H.A. (Idaho National Engineering Lab., Idaho Falls (USA)). Mar 1980. Contract EY-76-C-07-1570. 45p. Dep. NTIS, PC A03/MF A01.

The Slagging Pyrolysis Incinerator (SPI) Facility is being developed to process transuranic waste stored and buried at the Idaho National Engineering Laboratory (INEL) into a chemically inert, physically stable, basalt-like residue acceptable for a Federal Repository. A task force was established by the SPI Project Division to review and assess all aspects of criticality safety for the SPI Facility. This document presents the initial review, evaluations, and recommendations of the task force and includes the following: background information on waste characterization, and criticality

control approaches and philosophies, a description of the SPI Facility Waste Processing Building, a review and assessment of potentially relevant codes and regulations; a review and assessment of the present state of criticality and assaying/monitoring studies, and recommendations for changes in and additions to these studies. The review and assessment of potentially relevant codes and regulations indicate that ERDAM 0530, Nuclear Criticality Safety should be the controlling document for criticality safety for the SPI Project. In general, the criticality control approaches and philosophies for the SPI Project comply with this document.

20144 (EGG-WM—5116) **Low-level waste institutional waste incinerator program.** Thompson, J.D. (Idaho National Engineering Lab., Idaho Falls (USA)). Apr 1980. Contract EY-76-C-07-1570. 181p. Dep. NTIS, PC A09/MF A01.

Literature surveyed indicated that institutional LLW is composed of organic solids and liquids, laboratory equipment and trash, and some pathological waste. Some toxic and hazardous chemicals are included in the variety of LLW generated in the nation's hospitals, universities, and research laboratories. Thus, the incinerator to be demonstrated in this program should be able to accept each of these types of materials as feedstock. Effluents from the DOE institutional incinerator demonstration should be such that all existing and proposed environmental standards be met. A design requirement was established to meet the most stringent flue gas standards. LLW incineration practice was reviewed in a survey of institutional LLW generators. Incinerator manufacturers were identified by the survey, and operational experience in incineration was noted for institutional users. Manufacturers identified in the survey were contacted and queried with regard to their ability to supply an incinerator with the desired capability. Special requirements for ash removal characteristics and hearth type were imposed on the selection. At the present time, an incinerator type, manufacturer, and model have been chosen for demonstration.

20145 (ENICO—1032) **Description of a pilot plant to produce a pelleted form from simulated ICPP high-level calcined wastes.** Priebe, S.J.; Valentine, J.H. (Exxon Nuclear Idaho Co., Inc., Idaho Falls (USA)). Mar 1980. Contract AC07-79ID01675. 44p. Dep. NTIS, PC A03/MF A01.

The pilot plant uses techniques learned in the laboratory to combine calcine with solid and liquid binders to form hard, leach-resistant pellets. The pilot plant is designed to process up to 25 kg/h of calcine and will provide information necessary to verify the operational feasibility of pelletizing calcined waste. Also, information for the design of a possible full-scale pelletizing plant will be obtained. All components of the pelletizing operations are described. The solids feed system consists of two loss-in-weight feeders: one for calcine and one for solid binders. Intimate mixing of the solids is accomplished in a screw mixer-feeder. A metering pump is used to pump liquid binders to the pelletizer through a spray nozzle. A 12.7 mm mesh, vibro screen separator removes oversize pellets, leaving the pelletizer. A 0-6 kW microwave-heated dryer operating at 150 to 200°C removes moisture from the pellets in about 15 minutes. To impart leach resistance, the pellets are heat treated at 800 to 900°C for 1 to 2 hrs in a kiln. Pellets move down through a set of 6 to 8 stacked, rotating trays inside the kiln. Pellets are collected from the heat treater and tested for strength and leach resistance. An off-gas system cools and removes dust present in the off-gas from the pilot plant. 20 figures.

20146 (K/C—1383) **Waste oil disposal at the Department of Energy facilities at Oak Ridge, Tennessee.** Jones, J.R.; Mitchell, M.E.; Oakes, T.W.; Sanders, M. Stroud, D.D.; Tate, M.B. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 22 Apr 1980. Contract W-7405-ENG-26. 9p. Dep. NTIS, PC A02/MF A01.

The disposal of waste oil generated at the USDOE facilities in Oak Ridge has become a significant problem in recent years. The presence of radioactivity and other contaminants in some oils prohibits the use of commercial disposal and oil reclamation firms, and thus, often necessitates on-site disposal. Recent and proposed federal regulations have and will continue to control all waste oil disposal operations, including those of the Department of Energy. In order to ensure adequate and acceptable disposal of waste oils, a special committee of UCC-ND personnel located in Oak Ridge was established in December 1978 and asked to make appropriate recommendations for both near-term and long-range operations. Included in this paper is a brief description of the efforts of the committee, the associated efforts of development and engineering personnel, and conclusions and recommendations pertaining to UCC-ND waste oil disposal.

20147 (LA-UR—80-696) **Overview of the incinerator offgas system study.** Stretz, L.A. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 5p. (CONF-800313—6). Dep. NTIS, PC A02/MF A01.

From Waste management conference; Tucson, AZ, USA (10 Mar 1980).

The wide range of incineration designs under development or in operation for treatment of a variety of radioactive wastes has resulted in numerous offgas cleanup systems. A study has been undertaken to review current incineration and offgas systems, categorize the waste-incinerator-effluent cases, identify common offgas treatment problems and criteria, and establish class of readily available and required technology. This presentation discusses the general approach of the study and preliminary results from the incinerator and offgas systems review efforts.

20148 (RHO-CD—394) **Double shell slurry process test evaluation.** Honeyman, J.O.; Solbakken, M. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Apr 1978. Contract EY-77-C-06-1030. 25p. Dep. NTIS, PC A02/MF A01.

This report discusses results of a plant demonstration of the double shell slurry process which was conducted April 25 to 28, 1977. 274,000 gallons of double shell slurry were produced from 365,000 gallons of Hanford Defense Residual Liquor. The volume reduction was 25%. Process control was maintained near the proper zone in the early part of the run. However, the feed was underconcentrated in the latter part of the run. Hydroxide concentrations of the product samples ranged from 2.1 to 5.9 M. The aluminum to caustic ratio varied from 0.33 to 1.07. The solids were primarily sodium nitrate, carbonate, aluminate, and nitrate. All samples were totally water soluble. The double shell slurry product increased in volume by 19,000 gallons from April to October 1977, probably caused by organic chelating agents.

20149 (RHO-SA—51) **Removal of radionuclides from Hanford defense waste solutions.** Schulz, W.W. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Jan 1980. Contract EY-77-C-06-1030. 82p. (CONF-800607—30). Dep. NTIS, PC A05/MF A01.

From American Nuclear Society annual meeting; Las Vegas, NV, USA (8 Jun 1980).

The Hanford high-level defense wastes were characterized by their large volume (190,000 m^3) and varying content of inert and radioactive constituents. The water-soluble portion (140,000 m^3) of these wastes, which consists mainly of $NaNO_3$, $NaAl(OH)_4$, Na_2CO_3 and other sodium salts, contains a few milligrams of long-lived (t/sub 1/2/ $\geq$ 10 years) radionuclides per 1000 kilograms. There is probable economic incentive for long-term management of Hanford defense wastes to partition them into a small volume of highly radioactive material requiring high integrity immobilization and storage and a much larger fraction of low level (e.g., $<$ 10 nCi/g) waste which can be economically and safely stored in bulk form. To aid in achieving this latter objective, an integrated series of aqueous separations processes (precipitation, ion exchange, and solvent extraction methods) was designed to remove ^{137}Cs, ^{90}Sr, actinides, other multivalent cationic fission and activation products, and ^{99}Tc from the water-soluble wastes. Results of generally satisfactory laboratory-scale tests of radionuclide removal technology with actual Hanford wastes are described.

20150 (RHO-SA—98) **Ozonation of Hanford nuclear defense waste.** Lutton, T.W.; Schulz, W.W.; Strachan, D.M.; Bollyky, L.J. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Mar 1980. Contract EY-77-C-06-1030. 27p. (CONF-791182—1). Dep. NTIS, PC A03/MF A01.

From 4. international ozone conference; Houston, TX, USA (26 Nov 1979).

High (e.g., 0.1 to 0.5M) concentrations of ethylenediaminetetraacetate (EDTA), 2-hydroxyethylethylenediaminetriacetate (HEDTA), and other organic complexing agents are present in some of the nuclear waste solutions currently stored at the US Department of Energy Hanford Site in southeastern Washington State. Ozonolysis of these alkaline solutions smoothly and efficiently destroys the organic material thereby facilitating ion exchange removal of ^{90}Sr and other long-lived cationic radionuclides. Successful bench-scale ozonation tests have been performed with both synthetic and actual waste liquids.

20151 (RHO-ST—30) **Hanford radioactive tank cleanout and sludge processing.** Rasmussen, O.R. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Mar 1980. Contract AC06-77RL01030. 44p. Dep. NTIS, PC A03/MF A01.

The Hanford Site has successfully applied sluicing for the large-scale removal of radioactive sludges from underground storage tanks. The majority of the sludge recovery effort has been focused on retrieving relatively small quantities of sludge (2000 to 4000 gallons) for batchwise dissolution and shipment to uranium or fission product separation plants. Other efforts have involved transferring sludges between million-gallon tanks. The Hanford sluicing system uses a recirculating water inventory to carry sludge from underground storage tanks to the receiver. Equipment includes a medium pressure sluice pump (175 psi) in the slurry receiver tank, and a mechanical sluicing assembly and a slurry pump in the tank being sluiced. For batchwise sludge recovery, the water/slurry mixture is recirculated until the concentration reaches the 10 to 20 percent

solids range. The solids are then settled, the supernatant decanted to the sluice tank, and the solids remaining in the sludge receiver shipped to a dissolution tank for further processing. Seventy-five foot diameter underground storage tanks have been cleaned out to 2000 to 4000-gallon sludge heels.

20152 (PNL-TR—386) **Fabrication and characterization of an improved borosilicate glass for solidification of high-level fission-product solutions (HLW). Part 1. Studies of 25 borosilicate-glass products for selection of an improved borosilicate glass.** Guber, W.; Hussain, M.; Kahl, L.; Ondracek, G.; Saidl, J.; Dippel, T. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.)). 4 Feb 1980. Translation of KFK—2721, August 1979. 52p. Dep. NTIS, PC A04/MF A01.

The proportion of the glass constituents in the glass were varied. Taking gadolinia-containing waste into account, this approach led to 25 different basis glasses. Using the basic glasses and 15 wt % of inactive HLW oxides in each case, 25 borosilicate-glass products were melted in the laboratory, under conditions approximating the industrial fabrication process. The density, thermal conductivity, thermal expansion, characteristic temperatures, viscosity, specific heat, vaporization losses from the glass melt, electrical conductance, mechanical strength, hydrolytic resistance, crystallization behavior and tendency towards formation of additional phases were determined. On the basis of the individual values obtained, the glass products GP 98/12 (without Gd_2O_3) and GP 98/26 (with Gd_2O_3) were selected as improved matrix glasses for further characterization. The hydrolytic resistance, viscosity at 1420°K, crystallization tendency and tendency towards formation of further phases proved to be the most important.

WASTE DISPOSAL AND STORAGE

REFER ALSO TO CITATION(S) 20134, 20197, 20729, 21068, 21105, 21284

20153 (BNL-NUREG—27235) **Characterization of organics in leachates from low-level radioactive waste disposal sites.** Francis, A.J.; Iden, C.R.; Nine, B.; Chang, C. (Brookhaven National Lab., Upton, NY (USA); State Univ. of New York, Stony Brook (USA)). 1979. Contract EY-76-C-02-0016. 18p. (CONF-790602—93). Dep. NTIS, PC A02/MF A01.

From ANS annual meeting; Atlanta, GA, USA (3 Jun 1979).

Low-level radioactive wastes generated by the nuclear industry, universities, research institutions, and hospitals are disposed of in shallow-land trenches and pits. In 1962 the first commercial disposal site was opened in Beatty, Nevada. Since then, the industry has grown to include three private companies operating six disposal areas located in sparsely populated areas: at Maxey Flats (Morehead), Kentucky; Beatty, Nevada; Sheffield, Illinois; Barnwell, South Carolina; West Valley, New York; and Richland, Washington. Although the facilities are operated by private industry, they are located on public land and are subject to federal and state regulation. Although inventories of the radioactive materials buried in the disposal sites are available, no specific records are kept on the kinds and quantities of organic wastes buried. In general, the organic wastes consist of contaminated paper, packing materials, clothing, plastics, ion-exchange resins, scintillation vials, solvents, chemicals, decontamination fluids, carcasses of experimental animals, and solidification agents. Radionuclides such as ^{14}C, ^{3}H, ^{90}Sr, $^{134,137}Cs$, ^{60}Co, ^{241}Am, and $^{238,239,240}Pu$ have been identified in leachate samples collected from several trenches at Maxey Flats and West Valley. The purpose of this report is to identify some of the organic compounds present in high concentrations in trench leachates at the disposal sites in order to begin to evaluate their effect on radionuclide mobilization and contamination of the environment.

20154 (CONF-791103—98) **Interrelation of short-term leach tests and long-term leaching.** Compere, E.L.; Godbee, H.W. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 6p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

A standard leach test must permit accumulation of sufficient data to determine material parameters, such as figures of merit (FOMs) in a short time. Leach test results should be extended to other sizes, longer times, other temperatures, and other leaching solutions. This paper provides insights into the complexities in interpreting leach tests. (DLC)

20155 (CONF-791112—58) **Chemical reactions in the bedrock-groundwater system of importance for the sorption of actinides.** Beall, G.W.; Allard, B.; Krajewski, T.; O'Kelley, G.D. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 7p. Dep. NTIS, PC A02/MF A01.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1979).

Most suggested alternatives for deep underground disposal of high-level radioactive wastes rely upon several independent barriers like resistant canister materials, waste forms of low solubility in groundwaters and the use of back-fill material of low permeability and with nuclide retaining capacity. These barriers would retard the eventual release of radionuclides from the repository into the groundwater/bedrock system. The final and the only non-engineered barrier would be the host-rock itself. It would be desirable if the rock alone would be able to retain the long-lived radionuclides coming from the waste for long enough times to allow decay to harmless activity levels before they might reach the biosphere. The biological hazards from high-level reprocessng waste as well as from unreprocessed spent uranium fuel are dominated by the actinides and their daughter products (americium, plutonium, neptunium, thorium, radium) from about three hundred years after discharge from the reactor up to millions of years. In order to allow predictions of the migration of the actinides in the ground, the chemical behavior of these elements in groundwater under environmental conditions and their interactions with geologic media must be studied in detail. In this paper, studies of the sorption of americium (trivalent) and neptunium (pentavalent under oxic conditions) on some major rock-forming minerals of igneous rocks and accessory minerals are reported.

20156 (CONF-800416—1) **Chemical treatments of soil to decrease radiostrontium leachability.** Spalding, B.P. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 22p. Dep. NTIS, PC A02/MF A01.

From UCC-ND and GAT waste management seminar program; Portsmouth, OH, USA (22 Apr 1980).

The ready leachability of radiostrontium from radioactive waste is one of the most salient problems with shallow-land burial as a disposal method. The continuous leaching of buried waste at the Oak Ridge National Laboratory, for periods up to thirty years, has led to contamination of significant volumes of soil with ^{90}Sr. The goal of the present investigation was to evaluate methods to effect the in situ fixation or decrease the leachability of ^{90}Sr from soil. Small columns of three soils, collected from the solid waste disposal areas at ORNL, were labelled with ^{85}Sr as a convenient tracer for ^{90}Sr. After this labelling but prior to leaching, the soil columns were percolated with equivalent amounts of sodium salt solutions of hydroxide, fluoride, carbonate, phosphate, silicate, or aluminate. Leaching was then initiated with 0.1 N $CaCl_2$ (calcium chloride), and fractions of the leachate were analyzed for ^{85}Sr. The $CaCl_2$ solution was selected to qualitatively simulate groundwater which contains Ca as the dominant dissolved cation. With two soils which were high in indigenous exchangeable Ca, only 30 to 35% of the ^{85}Sr could be leached from the carbonate-treated columns. Presumably, the ^{85}Sr was coprecipitated with the nascent $CaCO_3$ formed during this treatment. In contrast, greater than 98% of the ^{85}Sr was readily leached from all untreated soils. Other anions fixed variable but generally less ^{85}Sr than the carbonate treatment. Thus, sodium carbonate appears to have potential application to immobilize ^{90}Sr in situ in contaminated soil.

20157 (CONF-800607—6) **Long-term subsurface migration of radionuclides from buried INEL transuranic waste.** Humphrey, T.G.; Smith, T.H. (EG and G Idaho, Inc., Idaho Falls (USA)). 1980. Contract EY-76-C-07-1570. 12p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society annual meeting; Las Vegas, NV, USA (8 Jun 1980).

Studies have been conducted to project long-term subsurface migration of radionuclides from transuranic (TRU-contaminated solid waste buried at the Idaho National Engineering Laboratory (INEL). Projections are given for several conceptual methods of waste confinement.

20158 (CONF-800611—1) **Management of alpha-contaminated wastes at the radioactive waste management complex at the Idaho National Engineering Laboratory.** McCormack, M.A. (EG and G Idaho, Inc., Idaho Falls (USA)). 1980. Contract EY-76-C-07-1570. 3p. Dep. NTIS, PC A02/MF A01.

From International symposium on the management of alpha-contaminated wastes; Vienna, Austria (2 Jun 1980).

Problems related to above ground storage of radioactive wastes at the Idaho National Engineering Laboratory and steps taken to resolve these difficulties are discussed. The quantity of wastes now in storage and the amount forecasted to be in place by 1985 are disclosed. The condition of containers placed for storage between 1954 and 1970 is described. Programs for retrieval and repackaging for shipment to federal repositories are discussed. (DC)

20159 (DOE/NE—0007) **Statement of position of the United States Department of Energy in the matter of proposed rulemaking on the storage and disposal of nuclear waste (waste confidence rulemaking).** (Nuclear Regulatory Commission, Washington, DC (USA)). 15 Apr 1980. 749p. Dep. NTIS, PC A99/MF A01.

Purpose of this proceeding is to assess generically the degree of assurance that the radioactive waste can be safely disposed of, to

determine when such disposal or off-site storage will be available, and to determine whether wastes can be safely stored on-site past license expiration until off-site disposal/storage is available. (DLC)

20160 (DP-MS—78-92) **Earthquake damage to underground facilities.** Pratt, H.R.; Stephenson, D.E.; Zandt, G.; Bouchon, M.; Hustrulid, W.A. (Terra Tek, Inc., Salt Lake City, UT (USA); Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1980. Contract EY-76-C-09-0001. 48p. (CONF-800603—1). Dep. NTIS, PC A03/MF A01.

From Rapid excavation and tunneling conference; Littleton, CO, USA (Jun 1980).

In order to assess the seismic risk for an underground facility, a data base was established and analyzed to evaluate the potential for seismic disturbance. Substantial damage to underground facilities is usually the result of displacements primarily along pre-existing faults and fractures, or at the surface entrance to these facilities. Evidence of this comes from both earthquakes and large explosions. Therefore, the displacement due to earthquakes as a function of depth is important in the evaluation of the hazard to underground facilities. To evaluate potential displacements due to seismic effects of block motions along pre-existing or induced fractures, the displacement fields surrounding two types of faults were investigated. Analytical models were used to determine relative displacements of shafts and near-surface displacement of large rock masses. Numerical methods were used to determine the displacement fields associated with pure strike-slip and vertical normal faults. Results are presented as displacements for various fault lengths as a function of depth and distance. This provides input to determine potential displacements in terms of depth and distance for underground facilities, important for assessing potential sites and design parameters.

20161 (HEDL-SA—1892-FP) **Survey test of canister, geology, and fuel cladding material interactions.** Krogness, J.C.; Almassy, M.Y.; Cantley, D.A.; Davis, R.B. (Hanford Engineering Development Lab., Richland, WA (USA)). Aug 1979. Contract EY-76-C-14-2170. 30p. (CONF-791033—7). Dep. NTIS, PC A03/MF A01.

From 1. annual ONWI information meeting; Columbus, OH, USA (30 Oct 1979).

Portions of document are illegible.

A series of Material Interaction Test (MIT) is being conducted. The first test is being conducted in the Dry Surface Storage Demonstration at the EMAD facility on NTS. This paper discusses details of this first test and gives a status report on the MIT series. 17 figures. (DLC)

20162 (HEDL-TC—1384(Rev.1)) **Spent fuel characterization for the commercial waste and spent fuel packaging program.** Fish, R.L.; Davis, R.B.; Pasupathi, V.; Klingensmith, R.W. (Hanford Engineering Development Lab., Richland, WA (USA); Battelle Columbus Labs., OH (USA)). Mar 1980. Contract EY-76-C-14-2170. 55p. Dep. NTIS, PC A04/MF A01.

This document presents the rationale for spent fuel characterization and provides a detailed description of the characterization examinations. Pretest characterization examinations provide quantitative and qualitative descriptions of spent fuel assemblies and rods in their irradiated conditions prior to disposal testing. This information is essential in evaluating any subsequent changes that occur during disposal demonstration and laboratory tests. Interim examinations and post-test characterization will be used to identify fuel rod degradation mechanisms and quantify degradation kinetics. The nature and behavior of the spent fuel degradation will be defined in terms of mathematical rate equations from these and laboratory tests and incorporated into a spent fuel performance prediction model. Thus, spent fuel characterization is an essential activity in the development of a performance model to be used in evaluating the ability of spent fuel to meet specific waste acceptance criteria and in evaluating incentives for modification of the spent fuel assemblies for long-term disposal purposes.

20163 (LA—8110-MS) **Sorption-desorption studies on tuff. II. Continuation of studies with samples from Jackass Flats, Nevada and initial studies with samples from Yucca Mountain, Nevada.** Vine, E.N.; Aguilar, R.D.; Bayhurst, B.P. (Los Alamos Scientific Lab., NM (USA)). Jan 1980. Contract W-7405-ENG-36. 75p. Dep. NTIS, PC A04/MF A01.

Distruibution coefficients were determined by a static (batch) technique for sorption-desorption of radionuclides between tuffs from drill holes UE25a No. 1 and J-13 at the Nevada Test Site and water from well J-13. Measurements were performed under atmospheric and controlled atmosphere conditions. Under atmospheric conditions tuffs high in zeolite minerals had sorption ratios of $\sim 10^3$ to 10^4 ml/g with Sr, Cs, Ba, Ce, Eu, Am, and Pu. For tuffs similar mineralogically to a microgranite the sorption ratios were $\sim 10^2$ to 10^3 ml/g. Values for U and Tc were obtained under controlled atmosphere (< 0.2 ppM O_2) conditions. Studies were also begun to measure distribution ratios by a dynamic (column) technique. The ratios obtained for the elements studied, Sr, Cs, and Ba, were similar to, although lower than, those obtained by batch methods.

20164 (NVO—196-14) **Nevada nuclear waste storage investigations. Quarterly report, October-December 1979.** (Department of Energy, Las Vegas, NV (USA). Nevada Operations Office). Mar 1980. 61p. Dep. NTIS, PC A04/MF A01.

Eight tasks are reported: Weapons Test Seismic Investigations, Geologic and Hydrologic Investigations, Media Investigations, Engineering and Technical Support, Quality Assurance, Technical Overview, Spent Fuel Test (Climax), and National Waste Terminal Storage Program Support.

20165 (ONWI—19(Rev.1)) **National Waste Terminal Storage Program. Office of Nuclear Waste Isolation technical program plan.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Dec 1979. Contract EY-76-C-06-1830. 131p. Dep. NTIS, PC A07/MF A01.

The National Waste Terminal Storage Program (NWTS) was established in 1976 with the objective of developing a system for the permanent isolation of nuclear wastes. DOE is charged with developing programs for the long term management of highly radioactive nuclear wastes by federal law. This legislation specifies that DOE must provide facilities for the successful isolation of these wastes from the biosphere in federally licensed and owned repositories for as long as they represent a significant hazard. The scope of NWTS activities includes providing the technology and facilities for the terminal isolation of commercial wastes by disposal in stable geologic repositories deep underground. Steps leading to the accomplishment of this purpose include: site exploration, characterization, and recommendation; design, licensing, construction, and operation of a geologic repository (or repositories); provision of spent fuel packaging and transportation facilities; technology to support these steps; and coordination of studies of altenate disposal concepts (i.e., deep hole, seabed, space, etc.). Emphasis is being placed on a system of multiple barriers - natural and man-made - to isolate nuclear waste from the environment. Because the nature of the host rock is basic to determination of other barriers, work in the geologic aspects of the multiple barrier system is well under way in several candidate media. Throughout the process, the NWTS Program has the responsibility to provide public information on all aspects of the program and to encourage public interaction.

20166 (ONWI—39(Vol.2)) **Assessment of LWR spent fuel disposal options. Volume 2. System definition and assessments. Technical report.** (Bechtel National, Inc., San Francisco, CA (USA)). Jul 1979. Contract EY-76-C-06-1830. 211p. Dep. NTIS, PC A10/MF A01.

Volume 2, in addition to introducing and defining the requirements for the study, contains the detailed evaluation of the study cases in each of six assessment areas, and describes and evaluates a number of study variations.

20167 (ONWI—39(Vol.3)) **Assessment of LWR spent fuel disposal options. Volume 3. Study bases and system design considerations (Appendices). Technical report.** (Bechtel National, Inc., San Francisco, CA (USA)). Jul 1979. Contract EY-76-C-06-1830. 462p. Dep. NTIS, PC A20/MF A01.

Volume 3 (Appendices) provides a tabulation of the bases and assumptions used in the study as well as preconceptual design description and cost estimates of the facilities and transportation systems necessary to implement the various study cases.

20168 (ONWI—59) **Disposal of spent nuclear fuel.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Dec 1979. Contract EY-76-C-06-1830. 72p. Dep. NTIS, PC A04/MF A01.

This report addresses the topic of the mined geologic disposal of spent nuclear fuel from Pressurized Water Reactors (PWR) and Boiling Water Reactors (BWR). Although some fuel processing options are identified, most of the information in this report relates to the isolation of spent fuel in the form it is removed from the reactor. The characteristics of the waste management system and research which relate to spent fuel isolation are discussed. The differences between spent fuel and processed HLW which impact the waste isolation system are defined and evaluated for the nature and extent of that impact. What is known and what needs to be determined about spent fuel as a waste form to design a viable waste isolation system is presented. Other waste forms and programs such as geologic exploration, site characterization and licensing which are generic to all waste forms are also discussed. R and D is being carried out to establish the technical information to develop the methods used for disposal of spent fuel. All evidence to date indicates that there is no reason, based on safety considerations, that spent fuel should not be disposed of as a waste.

20169 (ONWI—60) **Waste isolation performance assessment: a status report.** Burkholder, H.C. (Battelle Memorial Inst., Columbus, OH (USA)). Nov 1979. Contract EY-76-C-06-1830. 31p. Dep. NTIS, PC A03/MF A01.

The assessment of system performance following emplacement of the waste is a key activity in the development of nuclear waste isolation systems. The assessment results provide a technical

basis for decisions concerning site selection, repository design selection, engineered barrier selection, and system acceptability, and they bear directly on the central issue of nuclear waste isolation, Do the proposed isolation systems sufficiently protect humans from the waste. The objective of this paper is to describe the performance assessment problem, outline general approaches to its solution, and describe the status of the development, validation, and application of performance assessment technology.

20170 (ORNL/SUB—79/13837/1) **State of the art review of alternatives to shallow land burial of low level radioactive waste.** (Gilbert/Commonwealth, Jackson, MI (USA); Gilbert/Commonwealth, Reading, PA (USA)). Apr 1980. Contract W-7405-ENG-26. 101p. Dep. NTIS, PC A06/MF A01.

A review of alternatives to shallow land burial for disposal of low level radioactive waste was conducted to assist ORNL in developing a program for the evaluation, selection, and demonstration of the most acceptable alternatives. The alternatives were categorized as follows: (1) near term isolation concepts, (2) far term isolation concepts, (3) dispersion concepts, and (4) conversion concepts. Detailed descriptions of near term isolation concepts are provided. The descriptions include: (1) method of isolation, (2) waste forms that can be accommodated, (3) advantages and disadvantages, (4) facility and equipment requirements, (5) unusual operational or maintenance requirements, (6) information/technology development requirements, and (7) related investigations of the concept.

20171 (PB—296947, pp 62-66) **DOE's low-level waste management program.** Meyers, S. (Dept. of Energy, Washington, DC). May 1979.

From 12. Health Physics Society midyear topical symposium; Williamsburg, VA, USA (12 Feb 1979).

Government policies on the management of low-level radioactive wastes are discussed. The DOE program of radioactive waste disposal at DOE sites is described. Ten major program elements are highlighted: program management; systems analysis; criteria and standards development; public and regulatory interface; technology development; waste generation reduction; current systems operations; future systems development and acquisition, commercial wastes, and alternatives to shallow land burial. (DC)

20172 (PNL—2939) **Finite-element three-dimensional groundwater (FE3DGW) flow model - formulation, program listings and users' manual.** Gupta, S.K.; Cole, C.R.; Bond, F.W. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Dec 1979. Contract EY-76-C-06-1830. 283p. Dep. NTIS, PC A13/MF A01.

The Assessment of Effectiveness of Geologic Isolation Systems (AEGIS) Program is developing and applying the methodology for assessing the far-field, long-term post-closure safety of deep geologic nuclear waste repositories. AEGIS is being performed by Pacific Northwest Laboratory (PNL) under contract with the Office of Nuclear Waste Isolation (OWNI) for the Department of Energy (DOE). One task within AEGIS is the development of methodology for analysis of the consequences (water pathway) from loss of repository containment as defined by various release scenarios. Analysis of the long-term, far-field consequences of release scenarios requires the application of numerical codes which simulate the hydrologic systems, model the transport of released radionuclides through the hydrologic systems to the biosphere, and, where applicable, assess the radiological dose to humans. Hydrologic and transport models are available at several levels of complexity or sophistication. Model selection and use are determined by the quantity and quality of input data. Model development under AEGIS and related programs provides three levels of hydrologic models, two levels of transport models, and one level of dose models (with several separate models). This document consists of the description of the FE3DGW (Finite Element, Three-Dimensional Groundwater) Hydrologic model third level (high complexity) three-dimensional, finite element approach (Galerkin formulation) for saturated groundwater flow.

20173 (PNL—3160-3) **Variable thickness transient ground-water flow model. Volume 3. Program listings.** Reisenauer, A.E. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Dec 1979. Contract EY-76-C-06-1830. 236p. Dep. NTIS, PC A11/MF A01.

The Assessment of Effectiveness of Geologic Isolation Systems (AEGIS) Program is developing and applying the methodology for assessing the far-field, long-term post-closure safety of deep geologic nuclear waste repositories. AEGIS is being performed by Pacific Northwest Laboratory (PNL) under contract with the Office of Nuclear Waste Isolation (OWNI) for the Department of Energy (DOE). One task within AEGIS is the development of methodology for analysis of the consequences (water pathway) from loss of repository containment as defined by various release scenarios. Analysis of the long-term, far-field consequences of release scenarios requires the application of numerical codes which simulate the hydrologic systems, model the transport of released radionuclides through the hydrologic systems to the biosphere, and, where applicable, assess the radiological dose to humans. Hydrologic and transport models are available at several levels of complexity or sophistication. Model selection and use are determined by the quantity and quality of input data. Model development under AEGIS and related programs provides three levels of hydrologic models, two levels of transport models, and one level of dose models (with several separate models). This is the third of 3 volumes of the description of the VTT (Variable Thickness Transient) Groundwater Hydrologic Model - second level (intermediate complexity) two-dimensional saturated groundwater flow.

20174 (PNL—3161-4) **Assessment of effectiveness of geologic isolation systems. CIRMIS data system. Volume 4. Driller's logs, stratigraphic cross section and utility routines.** Friedrichs, D.R. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jan 1980. Contract EY-76-C-06-1830. 242p. 11.

The Assessment of Effectiveness of Geologic Isolation Systems (AEGIS) Program is developing and applying the methodology for assessing the far-field, long-term post-closure safety of deep geologic nuclear waste repositories. AEGIS is being performed by Pacific Northwest Laboratory (PNL) under contract with the Office of Nuclear Waste Isolation (ONWI) for the Department of Energy (DOE). One task within AEGIS is the development of methodology for analysis of the consequences (water pathway) from loss of repository containment as defined by various release scenarios. Analysis of the long-term, far-field consequences of release scenarios requires the application of numerical codes which simulate the hydrologic systems, model the transport of released radionuclides through the hydrologic systems to the biosphere, and, where applicable, assess the radiological dose to humans. The various input parameters required in the analysis are compiled in data systems. The data are organized and prepared by various input subroutines for use by the hydrologic and transport codes. The hydrologic models simulate the groundwater flow systems and provide water flow directions, rates, and velocities as inputs to the transport models. Outputs from the transport models are basically graphs of radionuclide concentration in the groundwater plotted against time. After dilution in the receiving surface-water body (e.g., lake, river, bay), these data are the input source terms for the dose models, if dose assessments are required. The dose models calculate radiation dose to individuals and populations. CIRMIS (Comprehensive Information Retrieval and Model Input Sequence) Data System is a storage and retrieval system for model input and output data, including graphical interpretation and display. This is the fourth of four volumes of the description of the CIRMIS Data System.

20175 (PNL-SA—7953) **Nature of glass leaching.** McVay, G.L.; Buckwalter, C.Q. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jul 1979. Contract EY-76-C-06-1830. 40p. (CONF-7909102—2). Dep. NTIS, PC A03/MF A01.

From Argonne specialists' workshop on basic research needs for nuclear waste management; Argonne, IL, USA (5 Sep 1979).

Several models have been proposed in the literature to describe glass leaching behavior in aqueous solutions, but they are primarily applicable to relatively simple glasses. Their shortcoming is that they do not incorporate enough of the phenomena occurring during leaching. Leaching characteristics of a complex waste containment glass are discussed. Gamma irradiation increases the leach rates. Since bulk diffusion does not play a major role in leaching, the existing models are totally indequate for complex glasses. 4 figures, 3 tables. (DLC)

20176 (PNL-SA—8011) **Radiological aspects of sea bed dumping in the deep oceans.** Templeton, W.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1979. Contract EY-76-C-06-1830. 19p. (CONF-791050—2). Dep. NTIS, PC A02/MF A01.

From 3. Nuclear Energy Agency seminar on marine radioecology; Tokyo, Japan (1 Oct 1979).

In order to control coastal discharges or ocean dumping of any kind of material, it is necessary to determine a release rate. This can only come from a knowledge of the composition and chemical form of the source materials, the distribution and bioavailability of these materials in the ocean ecosystem, the degree and rates of bioaccumulation and the actual or potential use of the ocean resources. With this information release rates within acceptable limits for man and the ecosystem can then be determined. Today, probably the only situations which apply this approach are the controlled disposal of radioactive wastes. In this paper a recent radiological assessment of the dumping of packaged radioactive wastes on the seabed is discussed and some environmental aspects of the United States Department of Energy program are described examining the feasibility of the emplacement of contained radioactive wastes within the deep ocean sediments.

20177 (PNL-TR—384) **CEDRA Informe: National Cooperative Association for the Storage of Radioactive Wastes.** 31 Jan 1980. Translation of CEDRA Informe, No. 6/1979 November. 34p. Dep. NTIS, PC A03/MF A01.

Activities of the CEDRA, a Swiss organization, in the field of radioactive waste storage are reported. Besides various international

cooperative projects, an underground laboratory will be constructed at Grimsel. International news briefs are included. The Swiss program for nuclear waste management is discussed. (DLC)

20178 (RHO-BWI—79-100-4Q) **Basalt Waste Isolation Project. Quarterly report, July 1, 1979-September 30, 1979.** Deju, R.A. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Oct 1979. Contract EY-77-C-06-1030. 58p. Dep. NTIS, PC A04/MF A01.

Progress in various areas of the Basalt Waste Isolation Project during the last quarter is reported. Systems integration, licensing, geologic activities, hydrology, borehole studies, geophysical logging, engineered barriers, test facilities, testing of canisters, and selection process for architect-engineer services for repository conceptual design are discussed. (DC)

20179 (RHO-BWI-SA—29) **Rate of deformation in the Pasco Basin during the Miocene as determined by distribution of Columbia River basalt flows.** Reidel, S.P.; Ledgerwood, R.K.; Myers, C.W.; Jones, M.G.; Landon, R.D. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Mar 1980. Contract EY-77-C-06-1030. 43p. (CONF-800342—1). Dep. NTIS, PC A03/MF A01.

From 76. annual meeting Cordilleran Section Geological Society of America; Corvallis, OR, USA (19 Mar 1980).

Detailed mapping of over 8000 square kilometers and logs from 20 core holes were used to determine the distribution and thickness of basalt flows and interbeds in the Pasco Basin. The data indicate the high-MgO Grande Ronde Basalt and Wanapum Basalt thicken from the northeast to the southwest. Deformation began in late Frenchman Springs time in the Saddle Mountains along a northwest-southeast trend and in Roza time along an east-west trend. By late Wanapum time, basalt flows were more restricted on the east side. Saddle Mountains Basalt flows spread out in the basin from narrow channels to the east. The Umatilla Member entered from the southeast and is confined to the south-central basin, while the Wilbur Creek, Asotin, Esquatzel, Pomona, and Elephant Mountain Members entered from the east and northeast. The distribution of these members is controlled by flow volume, boundaries of other flows, and developing ridges. The Wilbur Creek, Asotin, and Esquatzel flows exited from the basin in a channel along the northern margin of the Umatilla flow, while the Pomona and Elephant Mountain flows exited between Umtanum Ridge and Wallula Gap. The thickness of sedimentary interbeds and basalt flows indicated subsidence and/or uplift began in post-Grande Ronde time (14.5 million years before present) and continued through Saddle Mountains time (10.5 million years before present). Maximum subsidence occurred 40 kilometers (24 miles) north of Richland, Washington with an approximate rate of 25 meters (81 feet) per million years during the eruption of the basalt. Maximum uplift along the developing ridges was 70 meters (230 feet) per million years.

20180 (RHO-BWI-SA—32) **Chemical stratigraphy of Grande Ronde Basalt, Pasco Basin, south-central Washington.** Long, P.E.; Ledgerwood, R.K.; Myers, C.W.; Reidel, S.P.; Landon, R.D.; Hooper, P.R. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Feb 1980. Contract EY-77-C-06-1030. 33p. (CONF-800342—2). Dep. NTIS, PC A03/MF A01.

From 76. annual meeting Cordilleran Section Geological Society of America; Corvallis, OR, USA (19 Mar 1980).

Grande Ronde Basalt in the Pasco Basin, south-central Washington, can be subdivided into three chemical types and two chemical subtypes based on x-ray fluorescence major element analysis of samples from seven deep core holes and three surface sections. These chemical types are: (1) high-Mg Grande Ronde chemical type; (2) low-Mg Grande Ronde chemical type; (3) low-K (very high-Mg?) Grande Ronde chemical type; and (4) Umtanum Grande Ronde chemical subtype. A possible fifth subdivision is the McCoy Canyon Grande Ronde chemical subtype. The Umtanum and the McCoy Canyon subtypes are both single flows which belong to the low Mg and high-Mg chemical types, respectively. These subdivisions are all distinguished on a plot of MgO versus TiO_2 and/or MgO versus P_2O_5, but other major and minor elements, as well as trace elements, also reflect consistent chemical differences between the chemical types. Identification of these chemical types in the Pasco Basin subsurface shows that the high-Mg and low-Mg chemical types are ubiquitous, but the low-K chemical type is limited to the central, southern, and eastern parts of the basin. The Umtanum chemical subtype is present throughout the Pasco Basin subsurface, although it thins in the northeastern part of the basin and is apparently absent from surface exposures 40 kilometers (25 miles) north of the basin. The McCoy Canyon chemical subtype is also present throughout the basin.

20181 (SAND—79-1665) **Thermal conductivity of rocksalt and other geologic materials from the site of the proposed waste isolation pilot plant.** Sweet, J.N.; McCreight, J.E. (Sandia Labs., Albuquerque, NM (USA)). 19 Mar 1980. Contract EY-76-C-04-0789. 33p. Dep. NTIS, PC A03/MF A01.

The measurements first reported by Acton on the thermal conductivity of samples taken from a borehole at the site of the proposed nuclear waste isolation pilot plant (WIPP) near Carlsbad, NM, have been extended to include additional samples and higher temperature measurements. Samples for measurements were taken from several depths of three wells, including the well AEC 8 from which Acton obtained his samples. These samples ranged from relatively pure rocksalt (NaCl) with small amounts of interstitial anhydrite to essentially nonsalt samples composed of gypsum or clay. The measurements in this latest series were conducted at Sandia, the Los Alamos Scientific Laboratory (LASL), and at Dynatech Corp. In general, the data from the three laboratories agreed reasonably well for similar coarse grained translucent rock salt samples, with the LASL and Sandia results typically being about 20% higher than those of Dynatceh. On the basis of these experiments, it is concluded that the thermal conductivity of materials found at the site can be predicted to an accuracy +-30% from knowledge of the composition and grain size of these materials.

20182 (SAND—79-1679) **Seabed disposal project two-dimensional axisymmetric penetrometer simulations.** Chavez, P.F.; Dawson, P.R.; Schuler, K.W. (Sandia Labs., Albuquerque, NM (USA)). Mar 1980. Contract EY-76-C-04-0789. 54p. Dep. NTIS, PC A04/MF A01.

Preliminary two-dimensional, one-constituent hole closure analyses of an experimental apparatus and the flow of in situ ocean sediments following a penetrometer explacement have been performed. Boundary conditions associated with the experimental apparatus were found to greatly affect cavity response. Difficulties were encountered in modelling penetrometer-sediment interfaces and in obtaining smooth stress histories. The use of a different computer code in later analyses led to more realistic penetrometer-sediment interface models and to improved success in obtaining stress histories. These results along with some recommendations for future work are presented.

20183 (SAND—79-1889) **Strategy for investigation of fluid migration in evaporites (Waste Isolation Pilot Plant - WIPP).** Lambert, S.J.; Shefelbine, H.C. (Sandia Labs., Albuquerque, NM (USA)). Mar 1980. Contract EY-76-C-04-0789. 27p. Dep. NTIS, PC A03/MF A01.

The proposed strategy for WIPP project investigations of fluid migration in evaporites focuses upon a quantitative evaluation of each of several processes. Potential short- and long-term problems arising from fluid migration are complication of waste retrieval and mobilization of waste nuclides. The strategy will attempt to determine the degree to which these potentials are realized with respect to five hypothetical types of waste-rock interactions: movement of waste containers, migration of nuclides, formation of radioactive brine pocket, radiolytic generation of gas, and degradation of waste container. Of eight identified processes whose combinations could lead to the five types of interactions, only five are to be quantitatively investigated by the studies of fluid migration per se: presence of fluids, fluid mobilization toward heat-producing and contact-handled waste, encounter of fluids with influence of waste form, reversal of direction of fluid mobilization, and entrainment of nuclides in fluids. Methods of investigation entail an iterative combination of laboratory experimentation and mathematical modeling.

20184 (SAND—79-2216A) **Degradation of transuranic-contaminated wastes under geologic isolation conditions.** Molecke, M.A. (Sandia Labs., Albuquerque, NM (USA)). Nov 1979. Contract EY-76-C-04-0789. 3p. (CONF-800611—2). Dep. NTIS, PC A02/MF A01.

From International symposium on the management of alpha-contaminated wastes; Vienna, Austria (2 Jun 1980).

An extensive experimental study of the degradation of existing forms of defense-related, transuranic-contaminated (TRU) wastes is being conducted by and for Sandia Laboratories. Studies have been performed under environmental conditions expected for deep geologic isolation in the Waste Isolation Pilot Plant (WIPP), a bedded-salt TRU waste repository planned for southeastern New Mexico. A primary purpose of this program has been to support the US Department of Energy in establishing waste acceptance criteria for TRU wastes for isolation in the WIPP. TRU waste forms investigated include cellulosics (paper, rags, wood), plastics, rubbers, mixed organic composite, bitumen, a developmental concrete-TRU ash matrix, mild steel, and inorganic process sludges. This review includes laboratory and field results for waste degradation under a range of conditions, resultant gas generation rates, gas compositions, corrosion rates, and microbial formation and degradation of chelating agents.

20185 (SAND—79-2244C) **Thermal, chemical, and mass-transport processes induced in abyssal sediments by the emplacement of nuclear waste: experimental and modeling results.** McVey, D.F.; Erickson, K.L.; Seyfried, W. (Sandia Labs., Albuquerque, NM (USA); Minnesota Univ., Minneapolis (USA). Dept. of Geology).

1980. Contract EY-76-C-04-0789. 52p. (CONF-800420—3). Dep. NTIS, PC A04/MF A01.

From 2. international ocean disposal symposium; Woods Hole, MA, USA (15 Apr 1980).

This paper discusses heat and mass transport studies of marine red clay sediments being considered as a nuclear waste isolation medium. Numerical models indicate that for a maximum allowable sediment/canister interface temperature of 200 to 250°C, the sediment can absorb about 1.5 kW initial power from waste in a 3 m long by 0.3 m dia canister buried 30 m in the sediment. Fluid displacement due to convection is found to be less than 1 m. Laboratory studies of the geochemical effects induced by heating sediment/seawater mixtures indicate that the canister and waste form must be designed to resist a hot, acid (pH 3 to 4) oxidizing environment. Since the thermally altered sediment volume of about 5.5 m^3 is small relative to the sediment volume overlying the canister, the acid and oxidizing conditions are not anticipated to effect the properties of the far field. Using sorption coefficient correlations, the migration of four nuclides ^{239}Pu, ^{137}Cs, ^{129}I, and ^{99}Tc were computer for a canister buried 30 m deep in a 60 m thick red clay sediment layer. It was found that the ^{239}Pu and ^{137}Cs are essentially completely contained in the sediments, while ^{129}I and ^{99}Tc broke through the 30 m of sediment in about 5000 years. The resultant peak injection rates of 4.6×10^{-5} $\mu Ci/year\text{-}m^2$ for ^{129}I and 1.6×10^{-2} $\mu Ci/year\text{-}m^2$ for ^{99}Tc were less than the natural radioactive flux of ^{226}Ra (3.5 to 8.8×10^{-4} $\mu Ci/year\text{-}m^2$) and ^{222}Rn (0.26 to 0.88 $\mu Ci/year\text{-}m^2$).

20186 (SAND—79-2245C) **Strategy for assessing the technical, environmental, and engineering feasibility of subseabed disposal.** Anderson, D.R.; Boyer, D.G.; Herrmann, H.; Kelly, J.; Talbert, D.M. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 32p. (CONF-800420—2). Dep. NTIS, PC A03/MF A01.

From 2. international ocean disposal symposium; Woods Hole, MA, USA (15 Apr 1980).

This paper presents the strategy and management techniques used in the development of the US Subseabed Disposal Program (SDP) for possible disposal of both high-level waste and spent fuel. These have been developed through joint efforts of the Department of Energy (DOE), Division of Waste Isolation, the Sandia Technical Program Manager, the Technical Program Coordinators, the Advisory Group, and the Principal Investigators. Three subsections of this paper address the various components which make up the SDP strategy and management techniques. The first section will summarize the US DOE high-level waste and spent fuel disposal program and the position that the SDP occupies within that program. The second section, the Subseabed Program Plan, addresses the technical and administrative tools which are employed to facilitate the day-to-day operation of the SDP. The third section addresses the current studies and future plans for addressing the legal, political, and international uncertainties that must be resolved prior to the time the SDP reaches the final engineering phases.

20187 (SAND—79-2254C) **Measurements of very large deformations in potash salt in conjunction with an ongoing mining operation.** Sattler, A.R.; Christensen, C.L. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 10p. (CONF-800507—4). Dep. NTIS, PC A02/MF A01.

From Rock mechanics symposium; Rolla, MO, USA (27 May 1980).

Room and pillar deformation were measured in conjunction with a relatively new type of mining operation in a southeastern New Mexico potash mine. The extraction ration was approximately 90 percent in a first mining operation. Due to severe deformations encountered, instrumentation had to be developed/modified for these measurements. This paper concentrates on experiment design, design of special instrumentation, field installation of equipment, and presentation of the data. Measurements made include extensometers in the pillar, in the floor and ceiling in the room between pillars, absolute level measurements, floor ceiling closure, and stress (strain) measurements. Associated laboratory rock mechanics measurements of samples from the mine are being done separately. Two separate room pillar complexes were instrumented. In the first complex, floor-ceiling deformations of approximately 1 inch/day and pillar deformations around 1/2 inch/day were measured. In the second complex, instrumentation was installed while the pillar was a part of a long wall and the subsequent sequential mining (long wall-pillar with only one adjoining room on one side - pillar in the middle of room pillar complex) was observed. Data return from this operation was good.

20188 (SAND—79-7102) **Bibliography of marine radiation ecology prepared for the Seabed Program.** Schultz, V.S. (Lockheed Missiles and Space Co., Palo Alto, CA (USA)). Feb 1980. Contract EY-76-C-04-0789. 318p. Dep. NTIS, PC A14/MF A01.

References on the effects of ionizing radiation on aquatic organisms have been obtained from a number of sources. Many were obtained from reviews and other publications. Although the primary purpose of preparing this bibliography was to obtain information related to the nuclear wastes Seabed Disposal Biology Program of Sandia Laboratories, freshwater organisms are included as a matter of convenience and also with the belief that such a bibliography would be of interest to a wider audience than that restricted to the Seabed Program. While compilation of a list in an area broad in scope is often somewhat arbitrary, an attempt was made to reference publications that were related to field or laboratory studies of wild species of plants and animals with respect to radiation effects. Complete information concerning each reference are provided without excessive library search. Since one often finds references listed in the literature that are incompletely cited, it was not always possible to locate the reference for verification or completion of the citation. Such references are included where they appeared to be of possible value. When known, a reference is followed with its Nuclear Science Abstract designation, or rarely other abstract sources. Those desiring additional information should check Nuclear Science Abstracts utilizing the abstract number presented or other abstracting sources. In addition, the language of the article, other than English, is given when it is known to me.

20189 (SAND—80-0390C) **Sandia Borehole Plugging Program for the Waste Isolation Pilot Plant (WIPP).** Christensen, C.L. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 30p. (CONF-800527—1). Dep. NTIS, PC A03/MF A01.

From International BHP symposium; Columbus, OH, USA (7 May 1980).

This paper presents the current Borehole Plugging Program (BHP) at Sandia National Laboratories and addresses the four major functional tasks considered necessary for a successful program: (1) project management, including methods to identify, design, and control needed experimentation; (2) identification of candidate materials, emphasizing cement-based products as the most advanced alternatives due to the extensive existing technology base, but recognizing the potential application of alternate materials; (3) development of test instrumentation based on utilization of existing techniques, evaluation of their adequacy, and identifying modifications necessary to improve effectiveness; (4) field test program, which includes testing and verification of plug performance. The scope of the current program on wellbores, cementitious grouts, and available technology is compared to planned extension to shafts and drifts, alternate materials, and improved instrumentation. The relationship of this program with assessments of long-term suitability performed in the geochemical program is presented. A brief presentation of current and planned field tests is given along with projections for future activities and results.

20190 (UCID—18575) **Parameter identification in groundwater flow: a feasibility study.** Azevedo, S.G.; Doerr, T.A.; Candy, J.V.; Pimentel, K.D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Mar 1980. Contract W-7405-ENG-48. 57p. Dep. NTIS, PC A04/MF A01.

A set of first-order differential state equations is developed from taking finite differences of the partial differential equation that describes groundwater flow during a pump-drawdown test. The number of states in the model is a direct function of the number of discrete spatial segments used in the approximate model. This number of states is studied to determine a reasonably low-order model that preserves the accuracy of resulting simulations when compared with an available analytical solution. The resulting reduced-order model is then used in an extended Kalman filter for combined state and parameter estimation. This report summarizes work done in a recent pilot study to demonstrate the feasibility of these techniques in groundwater research and points the way toward other approaches to this problem area now under study.

20191 (UCID—18650) **Development and utilization of a two-dimensional model of transient fluid flow in a generic repository (OGRE).** Korver, J.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Oct 1979. Contract W-7405-ENG-48. 61p. Dep. NTIS, PC A04/MF A01.

An existing time-dependent numerical model (OGRE) has been modified to examine the time frames associated with repressuring the formation rocks surrounding a generic nuclear waste repository following the operational period when wastes are being stored. The model is two-dimensional in the vertical plane, and assumes that the entire regime is saturated, but the repository is at one atmosphere during the operational period. For the physical and geometric parameters assumed, the results of a simulation of the time necessary to repressurize the formation after the operational period was 421.5 years. These results were in close agreement with a steady-state calculation performed by Golder Associates, Inc., in 1977. The fact that the time-dependent model results were close to the steady-state calculation resulted from the use (in the model) of a very small compressibility value, which caused the simulation to reach a steady-state condition in a relatively short time. Based on these studies, the magnitude of the system (water plus matrix) compressibility is of great importance in determining whether the time for repressurization can be determined from analytical methods or requires the use of a time-dependent numerical model.

20192 (UCRL—15217) **Example of Monte Carlo analysis applied to repository siting.** Giuffre, M.S.; Kaplan, M.F. (Analytic Sciences Corp., Reading, MA (USA)). 31 Aug 1979. Contract W-7405-ENG-48. 54p. Dep. NTIS, PC A04/MF A01.

This report contains a detailed description of a Monte Carlo analysis of a hypothetical nuclear waste repository performed for the Lawrence Livermore Laboratory as part of their mock siting exercise. Field measurements had been used to construct a hydrology model of the geologic medium surrounding a nuclear waste repository, complete with specified uncertainties. The Monte Carlo analysis has been used to ascertain the uncertainty in the radioactive release from the repository given the uncertainty in the geohydrologic parameters, and correlation analysis has identified some input parameters that have a potentially large influence on the output (radioactivity release) uncertainty.

20193 **Industrial wastes: radioactive waste.** Blaylock, B.G. (ORNL). *J. Water Pollut. Control Fed.;* 50: No. 6, 1286-1291(Jun 1978).

To render high level radioactive waste nontoxic, isolation from humans and their environment is necessary for 500,000-1,000,000 years. A consensus is that only geological formations will maintain integrity this long. Numerous methods have been proposed. Literature on radioactive waste disposal is reviewed. Ice sheet disposal, ocean disposal, routine release of low level waste, treatment, land burial and storage, mathematic models for transport of dissolved radionuclides, and transuranics are surveyed. (42 references)

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 20136, 20154, 20164, 20188, 20192, 20199, 21176, 21186, 21188, 21218, 21235, 21236

20194 (K/C—1382) **Management of polychlorinated biphenyls at the ORGDP. Environmental protection.** Long, L.W. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 22 Apr 1980. Contract W-7405-ENG-26. 9p. Dep. NTIS, PC A02/MF A01.

The program for controlling the use, handling, storage, and disposal of polychlorinated biphenyls (PCBs) and PCB wastes at the ORGDP is described. Special emphasis is placed on the various administrative programs that have been incorporated to help ensure that plant personnel and the environment are adequately protected and that all applicable regulations are met.

20195 (LA—8285-PR) **Environmental and radiological safety studies: interaction of $^{238}PuO_2$ heat sources with terrestrial and aquatic environments. Progress report, October 1-December 31, 1979.** Waterbury, G.R. (comp.). (Los Alamos Scientific Lab., NM (USA)). Mar 1980. Contract W-7405-ENG-36. 45p. Dep. NTIS, PC A03/MF A01.

The containers for $^{238}PuO_2$ heat sources in radioisotope thermoelectric generators are designed with large safety factors to ensure that they will withstand reentry from orbit and impact with the earth and safely contain the nuclear fuel until it is recovered. The work discussed here includes studies of the effects on the heat source of terrestrial and aquatic environments to obtain data for design of even safer systems. The data obtained in several ongoing experiments are presented; these data tables will be updated quarterly. Compilations of usable data generated in each experiment are emphasized. These compilations include data from environmental chamber experiments that simulate terrestrial conditions, experiments to measure PuO_2 dissolution rates, soil column experiments to measure sorption of plutonium by soils, and several aquatic experiments.

20196 (PNL—2287) **Survey of LWR environmental control technology performance and cost.** Heeb, C.M.; Aaberg, R.L.; Cole, B.M.; Engel, R.L.; Kennedy, W.E. Jr.; Lewallen, M.A. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Mar 1980. Contract EY-76-C-06-1830. 194p. Dep. NTIS, PC A09/MF A01.

This study attempts to establish a ranking for species that are routinely released to the environment for a projected nuclear power growth scenario. Unlike comparisons made to existing standards, which are subject to frequent revision, the ranking of releases can be used to form a more logical basis for identifying the areas where further development of control technology could be required. This report describes projections of releases for several fuel cycle scenarios, identifies areas where alternative control technologies may be implemented, and discusses the available alternative control technologies. The release factors were used in a computer code system called ENFORM, which calculates the annual release of any species from any part of the LWR nuclear fuel cycle given a projection of installed nuclear generation capacity. This survey of fuel cycle releases was performed for three reprocessing scenarios (stowaway, reprocessing without recycle of Pu and reprocessing with full recycle of U and Pu) for a 100-year period beginning in 1977. The radioactivity releases were ranked on the basis of a relative ranking factor. The relative ranking factor is based on the 100-year summation of the 50-year population dose commitment from an annual release of radioactive effluents. The nonradioactive releases were ranked on the basis of dilution factor. The twenty highest ranking radioactive releases were identified and each of these was analyzed in terms of the basis for calculating the release and a description of the currently employed control method. Alternative control technology is then discussed, along with the available capital and operating cost figures for alternative control methods.

20197 (PNL—3304) **Monitoring and physical characterization of unsaturated zone transport. Laboratory analysis.** Gee, G.W.; Campbell, A.C. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Mar 1980. Contract EY-76-C-06-1830. 67p. Dep. NTIS, PC A04/MF A01.

Batch Kd screening tests on Hanford sediments indicated that anionic radionuclide mobility is dependent upon specie and concentration. Technetium, as TcO_4^-, is not sorbed to any extent and will move as rapidly as water. Iodine, as I^-, will also move at high concentrations (>5 ppB) but is retarded at very low concentrations (<1 ppB). Neutral species such as tritium and complexed nuclides such as cobalt-60 (EDTA) are only slightly retarded while uncomplexed cobalt-60 is strongly bound to the sediments under the conditions studied. Strontium sorption is controlled by ion exchange-like reactions and sorption is predictable from a knowledge of soil and solution characteristics. Cesium is strongly bound to the Hanford sediments under typical conditions and appears to be sorbed independent of salt concentration for the synthetic ground waters tested. The sorption of relatively mobile nuclides such as tritium, cobalt-EDTA, and technetium could be measured with greater precision using the unsaturated column tests than with batch methods. Little or no difference in sorption was observed when the flow rates were changed by more than an order of magnitude (2 to 50 cm/day). Changes in saturation percentage of the soil, from 56 to 31%, also had only a minor effect on nuclide sorption. For layered sediments, the effective sorption of a layered sequence is controlled by the sorption characteristics of the most sorbing layer.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 20136, 20166, 20167, 21019

20198 (CONF-791103—101) **Comparison of potential radiological impacts of ^{233}U and ^{239}Pu fuel cycles.** Meyer, H.R.; Little, C.A.; Witherspoon, J.P.; Till, J.E. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 5p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

Nuclear fuel cycl s utilizing ^{233}U are currently the subject of considerable interest in the United States. This paper focuses on the identification of significant differences between the off-site radiological hazards posed by $^{232}Th/^{233}U$ (Th/U) and $^{238}U/^{239}Pu$ (U/Pu) fuel cycles, and represents a portion of our involvement in the Nonproliferation Alternative Systems Assessment Program (NASAP), to be used in support of the International Fuel Cycle Evaluation (INFCE). The major contributors to radiological dose are likely to be uranium mining and milling (58.5% of total fuel cycle dose), reprocessing (33.9%), and light-water reactor power generation (7.3%). The remainder of the cycle, including enrichment processes, fuel fabrication, transportation, and waste management, contributes only 0.3% to total estimated fuel cycle dose.

20199 (K/C—1384) **ORGDP Hazardous Materials Management Program. Environmental protection.** Perry, T.P.A. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 22 Apr 1980. Contract W-7405-ENG-26. 9p. Dep. NTIS, PC A02/MF A01.

A description of the development and subsequent implementation of the ORGDP Hazardous Materials Management Program is presented. In addition to a general discussion of the major aspects of the program, specific examples of problems and solutions are presented.

20200 (ORNL—5457) **Assessment of the radiological impact of the inactive uranium-mill tailings at Grand Junction, Colorado.** Haywood, F.F.; Goldsmith, W.A.; Jacobs, D.G.; Perdue, P.T.; Ellis, B.S.; Hubbard, H.M. Jr.; Shinpaugh, W.H. (Oak Ridge National Lab., TN (USA)). Apr 1980. Contract W-7405-ENG-26. 92p. Dep. NTIS, PC A06/MF A01.

Results of a radiological survey of the inactive uranium-mill site at Grand Junction, Colorado, made in May and June 1976, are presented along with descriptions of techniques and equipment used to obtain the data and an assessment of increased risk of health effects attributable to radiation and radionuclides from the tailings. An estimate of potential health effects of exposure to gamma rays around a former mill building and to radon daughters produced by

radon dispersed from the tailings has been made for occupants of the site.

20201 (Y/DD—268) **External radiation monitoring of Union Carbide Corporation Nuclear Division personnel.** McLendon, J.D. (comp.). (Oak Ridge Y-12 Plant, TN (USA)). 26 Mar 1980. Contract W-7405-ENG-26. 29p. Dep. NTIS, PC A03/MF A01.

The health physics programs for monitoring personnel at the UCC-ND facilities are designed to measure and record any amount of ionizing radiation doses received by employees. These measurements include both external and internal exposures that personnel might receive during normal routine job assignments as well as during any accidental radiation incident. This report, prepared at the Oak Ridge Y-12 Plant, summarizes current practices at the UCC-ND facilities to monitor personnel for external radiation exposure. It is principally a compilation that highlights material available in various forms within the four installations: Oak Ridge National Laboratory (ORNL), Oak Ridge Y-12 Plant (Y-12), Oak Ridge Gaseous Diffusion Plant (ORGDP), and Paducah Gaseous Diffusion Plant (PGDP).

20202 (ANL-Trans—1185) **Radioprotection in the thorium production cycle.** Moraes, A. (Instituto de Radioprotecao e Dosimetria, Rio de Janeiro (Brazil)). Apr 1980. Translation of INIS-mf—4126, January 1977. 38p. Dep. NTIS, PC A03/MF A01.

The production of thorium concentrates from monazite sands involves numerous steps that have the potential to be sources of radiation exposure to workers. The production cycle as it is performed in Brazil is described as well as the radiation environment and procedures by which employees are protected from excess exposure. (ACR)

REGULATIONS

ACCOUNTABILITY AND SAFEGUARDS

REFER ALSO TO CITATION(S) 20127, 20128, 20166, 20167, 20947

20203 (CONF-791117—22) **Acid-compensated multiwavelength determination of uranium in process streams.** Bostick, D.T. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 8p. Dep. NTIS, PC A02/MF A01.

From ANS topical conference; Kiawah Island, SC, USA (26 Nov 1979).

Uranyl absorbance was measured in the presence of 0.02-5M HNO_3 to determine the effect of nitric acid concentration on the absorbance of uranium in the concentration range of 20 to 200 g/l. The uranyl absorbance was found to be primarily the result of three uranyl species: UO_2^{2+}, $UO_2NO_3^+$ and a uranyl dimer. The concentration of HNO_3 determines the relative concentration of each of these uranyl cations and, hence, their contribution to the total absorbance. Because UO_2^{2+} and $UO_2NO_3^+$ are the major uranyl species in streams containing excess acid (0.5-5M HNO_3), the absorbance at 416 and 426 nm is used to simultaneously calculate the total uranium and nitrate concentration in a stream to within 5% and 0.5 molar units, respectively. The uranyl absorbance in acid deficient aqueous streams (0.02 to 0.5M HNO_3) is due primarily to the absorbance of UO_2^{2+} and the uranyl dimer. As a result the absorbance at 416 and 426 nm can be used to simultaneously calculate the total uranium and hydrogen ion concentration in samples to within 3% and 0.2 molar units, respectively.

20204 (CONF-800607—26) **Evaluation of verification methods for input-accountability measurements.** Maeck, W.J. (Exxon Nuclear Idaho Co., Inc., Idaho Falls (USA)). 1980. Contract EY-76-C-07-1570. 3p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society annual meeting; Las Vegas, NV, USA (8 Jun 1980).

As part of TASTEX related programs two independent methods have been evaluated for the purpose of providing verification of the amount of Pu charged to the head-end of a nuclear fuel processing plant. The first is the Pu/U (gravimetric method), TASTEX Task-L, and the second is the Tracer Method, designated Task-M. Summaries of the basic technology, results of various studies under actual plant conditions, future requirements, are given for each of the Tasks.

20205 (DOE/DP—0001-5) **Strategic special nuclear material inventory differences. Semi-annual report.** (Department of Energy, Washington, DC (USA). Office of Safeguards and Security). Jan 1980. 25p. Dep. NTIS, PC A02/MF A01.

This report provides and explains the generally small differences between the amounts of nuclear materials charged to DOE facilities and the amounts that could be physically inventoried. These Inventory Differences, previously called Material Unaccounted For (MUF), are being publicly released on a semiannual basis. This report covers data for the period from October 1, 1978, through March 31, 1979, and includes accounting corrections for data from earlier periods.

20206 (DPSPU—79-30-16) **NDA for the SRP fuel fabrication process.** Studley, R.V. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). Dec 1979. Contract EY-76-C-09-0001. 21p. (CONF-791117—23). Dep. NTIS, PC A02/MF A01.

From ANS topical conference; Kiawah Island, SC, USA (26 Nov 1979).

The Savannah River Plant fuel fabrication process is described to illustrate requirements for a variety of assay techniques. Criteria and design of some NDA systems for this process are discussed. Initial performance of a neutron activation analysis system (californium shuffler) as an assay method for several varieties of material is reported. 25 figures.

20207 (LA-UR—80-689) **Nonintrusive irradiated fuel inventory confirmation technique.** Dowdy, E.J.; Nicholson, N.; Caldwell, J.T. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 6p. (CONF-800315—14). Dep. NTIS, PC A02/MF A01.

From 2. symposium of the European Safeguards Research and Development Association; Edinburgh, UK (26 Mar 1980).

Successful tests showing correlation between the intensity of the Cerenkov glow surrounding irradiated fuel assemblies in water-filled spent fuel storage ponds and the exposure and cooling times of assemblies have been concluded. Fieldable instruments used in subsequent tests confirmed that such measurements can be made easily and rapidly, without fuel assembly movement or the introduction of apparatus into the storage ponds.

20208 (LA-UR—80-740) **Potential improvements in materials accounting for an internationally safeguarded fuels reprocessing plant.** Hakkila, E.A.; Dayem, H.A.; Cobb, D.D.; Dietz, R.J.; Shipley, J.P. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 7p. (CONF-800315—11). Dep. NTIS, PC A02/MF A01.

From 2. symposium of the European Safeguards Research and Development Association; Edinburgh, UK (26 Mar 1980).

The effectiveness of improved materials accounting was evaluated using computer modeling, simulation, and analysis techniques for two model reprocessing plants. One plant, sized to 210 MTHM/yr, represents the small plants currently under international safeguards and the other, sized to 1500 MTHM/yr, represents the large plants expected in the future. The study indicates that conventional accounting may meet IAEA goal quantities and detection times for low-enriched uranium in these facilities. Dynamic materials accounting can meet the IAEA goal for detecting abrupt (1 to 3 wk) diversion of 8 kg of plutonium. Current materials accounting techniques probably cannot meet the protracted diversion goal of detecting 8 kg for plutonium in 1 yr. Facility design features that can improve the effectiveness of materials accounting in future plants are discussed.

20209 (LA-UR—80-741) **In-process inventory estimation for pulsed columns and mixer-settlers.** Cobb, D.D.; Burkhart, L.E.; Beyerlein, A.L. (Los Alamos Scientific Lab., NM (USA); Clemson Univ., SC (USA). Dept. of Chemistry; Ames Lab., IA (USA)). 1980. Contract W-7405-ENG-36. 8p. (CONF-800315—12). Dep. NTIS, PC A02/MF A01.

From 2. symposium of the European Safeguards Research and Development Association; Edinburgh, UK (26 Mar 1980).

Nuclear materials accounting and control in fuels reprocessing plants can be improved by near-real-time estimation of the nuclear materials inventory in solvent-extraction contactors. Techniques are being developed for the estimation of the in-process inventory in contactors. These techniques are derived from recent developments in chemical modeling of contactor systems, on-line measurements for materials accounting and control of the Purex process, and computer-based data acquisition and analysis methods.

20210 (LA-UR—80-755) **Application of a new containment and surveillance portal monitor data analysis method.** Pratt, J.C.; Henry, C.N.; Hastings, R.D. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 8 p. (CONF-800315—10). Dep. NTIS, PC A02/MF A01.

From 2. symposium of the European Safeguards Research and Development Association; Edinburgh, UK (26 Mar 1980).

A new method for processing the information available from an ordinary doorway monitor in an earlier report is described. Additional tests of this concept on doorway monitors at facilities of the Los Alamos Scientific Laboratory have been made. The lessons learned and estimates of the sensitivity of this method for detection of a trickle of special nuclear material through the portal are presented.

20211 (LA-UR—80-774) **DYMAC system: status and experience.** Malanify, J.J. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 7p. (CONF-800315—17). Dep. NTIS, PC A02/MF A01.

From 2. symposium of the European Safeguards Research and Development Association; Edinburgh, UK (26 Mar 1980).

The Dynamic Materials Accountability (DYMAC) system has been in operation at the Plutonium Processing Facility at the Los Alamos Scientific Laboratory since January 1978. The current status of this development and demonstration program, as well as the achieved operational experience, is reported.

20212 (SAND—79-1700) **Microprocessor-controlled tester for evaluation of the Self-Energized Credential System (SECS).** Corlis, N.E. (Sandia Labs., Albuquerque, NM (USA)). Mar 1980. Contract EY-76-C-04-0789. 59p. Dep. NTIS, PC A04/MF A01.

The Self-Energized Credential System (SECS) was developed for use in the Plutonium Protection System (PPS) installed at Hanford, Washington. Evaluation and development of the SECS system was enhanced by the use of a microprocessor-controlled portal tester. This tester used infrared (ir) beam sensors to provide information on the direction of travel of the credential wearer and to detect inoperative credentials. A printed record of the portal number, actual code read, time, and direction of the credential passage provided information essential to an assessment of the operability of the SECS.

20213 (SAND—80-0721C) **Systems approach to tamper protection.** Myre, W.C.; Eaton, M.J. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 5p. (CONF-800315—18). Dep. NTIS, PC A02/MF A01.

From 2. symposium of the European Safeguards Research and Development Association; Edinburgh, UK (26 Mar 1980).

Tamper-protection is a fundamental requirement of effective containment and surveillance systems. Cost effective designs require that the tamper protection requirements be considered early in the design phase and at the system level. A discussion of tamper protection alternatives as well as an illustrative example system is presented.

20214 (SAND—80-7026) **Automated psychological stress detection in an entry portal system. Final report.** Davis, J.G.; Loeppky, J.A.; Venters, M.D. (Lovelace Medical Foundation, Albuquerque, NM (USA). Clinical Research Div.). Oct 1979. Contract EY-76-C-04-0789. 35p. Dep. NTIS, PC A03/MF A01.

This report discusses the application of automatic psychological stress detection to persons entering a secured facility through an entry portal. The report presents the numerous technical considerations in transducing the required physiological signals. Also discussed are the major methods that a psychologically stressed person might utilize in an attempt to evade detection. The prime evasionary method of drug intervention is given added emphasis. Finally, the hardware requirements for a typical installation are presented.

20215 (UCRL—82225) **Real time loss detection for SNM in process.** Candy, J.V.; Dunn, D.R.; Gavel, D.T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 Mar 1980. Contract W-7405-ENG-48. 9p. (CONF-800315—16). Dep. NTIS, PC A02/MF A01.

From 2. symposium of the European Safeguards Research and Development Association; Edinburgh, UK (26 Mar 1980).

This paper discusses the basis of a design for real time special nuclear material (SNM) loss detectors. The design utilizes process measurements and signal processing techniques to produce a timely estimate of material loss. A state estimator is employed as the primary signal processing algorithm. Material loss is indicated by changes in the states or process innovations (residuals). The design philosophy is discussed in the context of these changes.

20216 (Y—2219) **Statistical analysis of nuclear material weighing systems at the Oak Ridge - Y-12 plant.** Hammer, A.H. (Oak Ridge Y-12 Plant, TN (USA)). Apr 1980. Contract W-7405-ENG-26. 26p. Dep. NTIS, PC A03/MF A01.

The variation in weight measurements on the electronic scales purchased for the Dynamic Special Nuclear Materials Control and Accountability System (DYMCAS) has been characterized and estimated to be more than is acceptable when using the current weighing methods. New weighing procedures have been developed which substantially reduce this variation and bring the weight errors within the Y-12 Plant Nuclear Materials Control and Accountability Department's desired +- 2-g accuracy.

20217 **Self-multiplication correction factors for neutron coincidence counting.** Ensslin, N.; Stewart, J.E.; Sapir, J. (Los Alamos Sci Lab, NM). *Nucl. Mater. Manage.;* **8**: No. 2, 60-73(1979).

The authors have developed self-multiplication correction factors for the nondestructive assay of plutonium oxide or metal in thermal or fast neutron coincidence counters. One correction consists of a series of curves for oxide derived from a Monte Carlo simulation of coincidence counting. Another correction is an approximate, geometry-independent formula which is applicable to any well-characterized material. Both correction factors are compared with measurements. 15 refs.

20218 **Performance analysis of nuclear materials accounting systems.** Cobb, D.D.; Shipley, J.P. (Los Alamos Sci Lab, NM). *Nucl. Mater. Manage.;* **8**: No. 2, 81-92(1979).

Techniques for analyzing the level of performance of nuclear materials accounting systems in terms of the four performance measures, total amount of loss, loss-detection time, loss-detection probability, and false-alarm probability, are presented. These techniques are especially useful for analyzing the expected performance of near-real-time (dynamic) accounting systems. A conservative estimate of system performance is provided by the CUSUM (cumulative summation of materials balances) test. Graphical displays, called performance surfaces, are developed as convenient tools for representing systems performance, and examples from a recent safeguards study of a nuclear fuels reprocessing plant are given. 6 refs.

ADMINISTRATIVE AND REGULATORY

REFER ALSO TO CITATION(S) 20159

20219 (PB—299080) **Licensed fuel facility status report. volume 1, number 3. data for decisions, fuel cycle operations. Status summary report.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Inspection and Enforcement). Jul 1979. 77p. NTIS PC A05.

The Licensed Fuel Facility Status Report (NUREG-0430) is a periodic report routinely providing information on licensed fuel facilities. This report identifies the licensee and the plant status, along with NRC inspection results and summaries through Dec. 31, 1978. The report includes licensee performance data as identified: (1) Licensee event reports as required by 10 CFR Parts 20, 40, 50, 70, 71 and 73 and by license conditions; (2) The quantities of radioactive materials released to the environment via gaseous or liquid effluent as required to be reported by 10 CFR 40.65 and 70.59; and (3) Inventory difference data, commonly referred to as 'MUF' (Material Unaccounted For), for those fuel cycle facilities which possess significant quantities of strategic special nuclear material or low enriched uranium. The time period covered by the data in this report is July 1, 1978 - December 31, 1978.

20220 **Near-surface heater experiments in argillaceous rocks.** Tyler, L.D.; Cuderman, J.F.; Krumhansl, J.L.; Lappin, A. (Sandia Labs., Albuquerque, NM (USA)). pp 31-43 of In situ heating experiments in geological formations. Seminar, Ludvika, Sweden, 13-15 Sep 1978. Proceedings. Paris, France; OECD (1978).

Full-scale near-surface heater experiments are presently being conducted by Sandia Laboratories in the Conasauga Formation at Oak Ridge, Tennessee, and in the Eleana Formation on the Nevada Test Site, Nevada. The purposes of these experiments are: 1) to determine if argillaceous media can withstand thermal loads characteristic of high level waste; 2) to provide data for improvement of thermomechanical modeling of argillaceous rocks; 3) to identify instrumentation development needed for further in situ testing; and 4) to identify unexpected general types of behavior, if any. The basic instrumentation of these tests consists of a heater in a central hole, surrounded by arrays of holes containing various instrumentation. Temperatures, thermal profiles, vertical displacements, volatile pressurization, and changes in in situ stresses are measured in each experiment as a function of time, and compared with pretest modeling results. Results to date, though in general agreement with modeling results assuming conductive heat transfer within the rock, indicate that the presence of even small amounts of water can drastically affect heat transfer within the heater hole itself and that small amounts of upward convection of water may be occurring in the higher temperature areas of the Conasauga experiments.

FUSION FUELS

PROCESSING

FABRICATION AND TESTING

20221 (KMSF-U—907) **Engineering aspects of cryogenic laser-fusion targets.** Musinski, D.L.; Henderson, T.M.; Simms, R.J.; Pattinson, T.R.; Jacobs, R.B. (KMS Fusion, Inc., Ann Arbor, MI (USA); Jacobs (R.B.) Associates, Inc., Boulder, CO (USA)). 6 Jun 1979. Contract AC08-78DP40030. 33p. (CONF-790815—36). Dep. NTIS, PC A03/MF A01.

From Cryogenic engineering conference; Madison, WI, USA (21 Aug 1979).

Most current laser-fusion targets consist of hollow spherical glass shells which have been filled with a mixture of gaseous deuterium-tritium fuel. Theoretical considerations suggest that optimum yields can be obtained from these targets if the fuel is condensed as a uniform liquid or solid layer on the inner surface of the

glass shell at the time it is irradiated. In principle, this can be accomplished in a straightforward way by cooling the target below the condensation or freezing point of the fuel. In practice, cryogenic targets can appear in routine laser experiments only when the necessary cryogenic technology is reliably integrated into experimental target chambers. Significant progress has been made recently in this field. The authors will discuss the scientific basis and the various engineering features of a system which has allowed the successful irradiation of uniform solid-fuel-layer targets.

20222 (UCRL—15212) **Investigation on cryogenic laser fusion targets: fabrication, characterization, and transport. Annual report, December 1, 1978-November 30, 1979.** Kim, K. (Illinois Univ., Urbana (USA). Dept. of Electrical Engineering). 1979. Contract W-7405-ENG-48. 42p. Dep. NTIS, PC A03/MF A01.

The research has been directed toward fabrication, characterization, and positioning of cryogenic shell laser fusion targets, with particular emphasis on the development of a scheme which would allow for continuous fabrication, inspection, and delivery of the targets. Specifically, progress has been made in the following areas: (1) Fabrication of a uniform spherical shell of DT-condensate using a cold-wall target-freezing-cell. (2) Fabrication of a uniform spherical shell of liquid DT using a room-temperature wall target-freezing-cell. (3) Support-free cryogenic target fabrication using cold-gas-levitation. (4) Continuous fabrication of cryogenic targets using free-fall method. (5) Automatic characterization of DT-layer uniformity. (6) Sorting of DT-filled glass microshells using an interference microscope. (7) Development of an a-c interference microscope for accurate characterization of moving targets. (8) Development of a machine which is capable of producing a continuous stream of uniform DT spheres of controllable sizes. (9) Theoretical study on the behavior of liquid hydrogen contained in a spherical shell. (MOW)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

RADIATION SOURCES

REFER ALSO TO CITATION(S) 20895, 21362

ISOTOPIC POWER SUPPLIES

REFER ALSO TO CITATION(S) 20195

20223 (LA—8279-PR) **General-purpose heat source project and space nuclear safety and fuels program. Progress report.** Maraman, W.J. (comp.). (Los Alamos Scientific Lab., NM (USA)). Dec 1979. Contract W-7405-ENG-36. 34p. Dep. NTIS, PC A03/MF A01.

This formal monthly report covers the studies related to the use of $^{238}PuO_2$ in radioisotopic power systems carried out for the Advanced Nuclear Systems and Projects Division of the Los Alamos Scientific Laboratory. The two programs involved are general-purpose heat source development and space nuclear safety and fuels. Most of the studies discussed hear are of a continuing nature. Results and conclusions described may change as the work continues.

20224 (LA—8311-PR) **General-purpose heat source project and space nuclear safety and fuels program. Progress reportt, January 1980.** Maraman, W.J. (comp.). (Los Alamos Scientific Lab., NM (USA)). Apr 1980. Contract W-7405-ENG-36. 25p. Dep. NTIS, PC A02/MF A01.

This formal monthly report covers the studies related to the use of $^{238}PuO_2$ in radioisotopic power systems carried out for the Advanced Nuclear Systems and Projects Division of the Los Alamos Scientific Laboratory. The two programs involved are the general-purpose heat source development and space nuclear safety and fuels. Most of the studies discussed here are of a continuing nature. Results and conclusions described may change as the work continues. Published reference to the results cited in this report should not be made without the explicit permission of the person in charge of the work.

20225 (PNL—1845-45) **Quarterly report on the strontium heat source development program, advanced nuclear systems and projects division for October-December 1979.** Fullam, H.T. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jan 1980. Contract EY-76-C-06-1830. 10p. Dep. NTIS, PC A02/MF A01.

The 30,000-h compatibility tests with $^{90}SrF_2$ were completed, and the test capsules were shipped to Oak Ridge National Laboratory for sectioning and metallographic examination. The 23 Hastelloy S and Hastelloy C-4 prototype outer capsules to be used in the qualification tests were radiographed and helium leak-checked. None of the capsules leaked, but radiographs of the capsule welds showed that weld penetration was only 50 to 70% of the desired amount. It has been decided to reweld the five capsules to be used for the impact (drop) test; the other capsules will be tested without being rewelded. Some prototype outer capsules will be qualification tested in the as-fabricated condition, while others will be tested after aging for 8000 h at 650°C and 725°C.

DESIGN AND FABRICATION

20226 (PNL—3204) **Stress analysis and testing of the outer capsule design for the Strontium Heat Source Development Program.** Simonen, F.A.; Shippell, R.J. Jr.; Atteridge, D.G. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jan 1980. Contract EY-76-C-06-1830. 71p. Dep. NTIS, PC A04/MF A01.

The objective of the Strontium Heat Source Development Program is to obtain the data needed to license $^{90}SrF_2$ heat sources - specifically the $^{90}SrF_2$ capsules produced in the Waste Encapsulation and Storage Facility (WESF) at Hanford. Toward this end, a high integrity outer capsule has been designed to replace the present outer capsule of the WESF $^{90}SrF_2$ capsule. The proposed design of a Hastelloy S outer capsule which features a mechanical interlock type of end closure is described. Qualification testing requirements are outlined, and stress analyses and developmental tests are described. These tests were performed on AISI-1018 steel stand-in capsules, and included both external pressure and impact tests. The external pressure tests showed that stress calculations seriously overestimated the pressure capability of the outer capsule. Possible reasons for the lack of agreement between the tests and the analyses are evaluated. The stress analyses and tests results indicate that the proposed outer capsule will meet the heat source qualification requirements. Future tests will be conducted to experimentally verify that the Hastelloy S outer capsule in an aged condition meets the structural integrity requirements.

USES

20227 (PB—80-101116) **Implanted energy conversion system. Annual report, 1 May 1978-1 March 1979.** Johnston, R.P.; Bennett, A.; Emigh, S.G.; Gray, D.H.; Noble, J.R. (Joint Center for Graduate Study, Richland, WA (USA)). Aug 1979. Contract N01-HV-4-2901. 487p. NTIS, PC A21/MF A01.

The JCGS thermal energy converter program objective is to develop clinically useful permanently implantable Stirling/hydraulic power sources to operate heart-assist or full-heart replacement blood pumps. The energy source is heat from an electric heater or from a radioisotope which could provide complete system implantability. Development has progressed through seven system configurations. Stirling Engine 5 has accumulated 6.3 years of operating time and has demonstrated 4.1 years of maintenance-free operation before failure. The short-stroke pump actuator/controller on accelerated life test has demonstrated 6.6 equivalent years of maintenance-free life without failure and accumulated a total of 16.5 equivalent years of operation. System 5 in-vivo test demonstrated circulation of all systemic blood flow throughout 175-hour test. System 6 complete power source demonstrated 15.5% efficiency, 1.2 liter volume, and 2.4 kg weight. System 7 engine module has demonstrated 20.1% efficiency with 0.2 liter volume and 0.7 kg weight.

HYDROGEN

PRODUCTION

THERMOCHEMICAL PROCESSES

REFER ALSO TO CITATION(S) 20331, 20332

20228 **Cyclic thermochemical process for producing hydrogen using cerium-titanium compounds.** Bamberger, C.E. US Patent Application 047,447. [nd]. 13p.

A thermochemical cyclic process for producing hydrogen employs the reaction between ceric oxide and titanium dioxide to form cerium titanate and oxygen. The titanate is treated with an alkali metal hydroxide to give hydrogen, ceric oxide, an alkali metal titanate and water. Alkali metal titanate and water are boiled to give titanium dioxide which, along with ceric oxide, is recycled.

20229 (CONF-791204—35) **Thermochemical water-splitting cycles based upon reactions of cerium- and alkaline earth phosphates.** Robinson, P.R.; Bamberger, C.E. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 5p. Dep. NTIS, PC A02/MF A01.

From 2. Miami international conference on alternative energy sources; Miami Beach, FL, USA (10 Dec 1979).

Cerium(IV) oxide, CeO_2, reacts with derivatives of phosphoric acid, metaphosphate salts, and pyrophosphate salts at 600 to 1000°C to produce oxygen and cerium(III) phosphates. The cerium(III) phosphates are oxidized to CeO_2 by steam at 700 to 1200°C in the presence of alkaline earth oxides, carbonates, or halides. These two sets of reactions form the basis for a family of thermochemical cycles based upon the redox couple Ce(IV)/(III).

20230 (LA-UR—80-500) **Interfacing primary heat sources and cycles for thermochemical hydrogen production.** Bowman, M.G. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 11p. (CONF-800616—2). Dep. NTIS, PC A02/MF A01.

From 3. world hydrogen energy conference; Tokyo, Japan (23 Jun 1980).

Advantages cited for hydrogen production from water by coupling thermochemical cycles with primary heat include the possibility of high efficiencies. These can be realized only if the cycle approximates the criteria required to match the characteristics of the heat source. Different types of cycles may be necessary for fission reactors, for fusion reactors or for solar furnaces. Very high temperature processes based on decomposition of gaseous H_2O or CO_2 appear impractical even for projected solar technology. Cycles based on CdO decomposition are potentially quite efficient and require isothermal heat at temperatures that may be available from solar furnaces of fusion reactors. Sulfuric acid and solid sulfate cycles are potentially useful at temperatures available from each heat source. Solid sulfate cycles offer advantages for isothermal heat sources. All cycles under development include concentration and drying steps. Novel methods for improving such operations would be beneficial.

20231 (LA-UR—80-525) **LASL bismuth sulfate thermochemical hydrogen cycle.** Cox, K.E.; Jones, W.M.; Peterson, C.L. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 21p. (CONF-800616—1). Dep. NTIS, PC A02/MF A01.

From 3. world hydrogen energy conference; Tokyo, Japan (23 Jun 1980).

The LASL bismuth sulfate cycle is one of a generic class of solid sulfate cycles in which a metal sulfate is substituted for sulfuric acid in a hybrid (partly electrochemical) cycle. This technique avoids the serious materials and heat penalty problems associated with the handling of concentrated acid solutions, and if the electrolyzer is operated at acid concentrations below 50% it may, in principle, lead to a lower cell voltage with subsequent energy savings. Experiment verification of all steps in the cycle has been obtained, particularly for the decomposition of normal bismuth sulfate and lower bismuth oxysulfates. For the substance, Bi_2O_3 $2SO_3$, an endothermic requirement of 172 kJ/mol was obtained, which is considerably less than that for other metal sulfate systems. A rotary kiln was used for continuous experiments and our results show decomposition of this compound to Bi_2O_3 SO_3 in under 8 minutes residence time at 1023 K. Preliminary analysis of the cycle's energy balance shows an overall thermal efficiency of greater than 50% when the maximum cycle reaction temperature is 1500 K. The cycle has potential for hydrogen production when coupled with an energy source such as solar or fusion energy.

20232 (LA-UR—80-579) **Cadmium-cadmium carbonate cycle for the thermochemical production of hydrogen.** Mason, C.F.V.; Bowman, M.G. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 14p. (CONF-800616—3). Dep. NTIS, PC A02/MF A01.

From 3. world hydrogen energy conference; Tokyo, Japan (23 Jun 1980).

A means of thermally decomposing water using cadmium, cadmium oxide and cadmium carbonate is described. Experimental emphasis is placed on the hydrogen producing step which consists of reacting cadmium with water and carbon dioxide to produce cadmium carbonate and hydrogen. The cycle is completed by decomposing the carbonate, first to the oxide, and then to the metal. Laboratory studies show that hydrogen is evolved slowly in relatively high yields (57 to 65%), but, when produced in the presence of ammonium chloride, both the yield and rate are increased (72% in 0.5 hr). The figure of merit of the cycle is 78% with a probability of some decrease resultant from the ammonium chloride reaction.

20233 (LA-UR—80-618) **Reaction of metal sulfates with molybdenum oxide, a high temperature reaction step for thermochemical cycles.** Hollabaugh, C.M.; Wallace, T.C.; Bowman, M.G.; Jones, W.M. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 9p. (CONF-800616—4). Dep. NTIS, PC A02/MF A01.

From 3. world hydrogen energy conference; Tokyo, Japan (23 Jun 1980).

The reaction of sulfates with molybdenum oxide at high temperature was studied to determine the feasibility of using these reactions in a thermochemical process for making hydrogen. The experiments were performed by heating the blended powders to temperatures of 1075 K and higher and analyzing the evolved gas for acid content. It was found that the reaction rate over the first few minutes increased with both temperature and MoO_3. The fraction of sulfate reacting in the first 5 minutes varies with cation used. At 1125 K and for a molar ratio of sulfate ion/MoO_3 of 0.5, the fraction reacted was 0.29 for $BaSO_4$, 0.32 for $CaSO_4$ and 0.82 for $La_2(SO_4)_3$. These results are encouraging and indicate that an alternative means to sulfuric acid drying and decomposition is feasible using a mixed sulfate/oxide system to lower the effective decomposition temperature of the insoluble sulfate.

20234 (UCRL—83540) **Utilization of $ZnSO_4$ decomposition in thermochemical hydrogen cycles.** Krikorian, O.H.; Hosmer, P.K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Feb 1980. Contract W-7505-ENG-48. 14p. (CONF-800616—5). Dep. NTIS, PC A02/MF A01.

From 3. world hydrogen energy conference; Tokyo, Japan (23 Jun 1980).

It was found that the $ZnSO_4$ decomposition reaction can be used as the high temperature step in a number of thermochemical cycles. It is especially applicable as a substitute for the H_2SO_4 decomposition step in H_2SO_4-based cycles, and significantly improves the efficiency of such cycles. In this study, the effects of heatup rate on the decomposition of $ZnSO_4$ as it is heated through an α-β transition at 1015 K were looked at. It was found that a rapid heatup of fine $ZnSO_4$ particulates through this transition leads to fracturing of the $ZnSO_4$ crystallites and significantly enhances its subsequent decomposition rate at ~ 1043 K. Evidence was found for an autocatalytic decomposition process in fine $ZnSO_4$ particulates with either rapid or slow heatup rates. We believe that a combination of (1) fracturing of the crystallites, and (2) surface catalysis by ZnO to equilibrate the SO_3/SO_2/O_2 gaseous products, contributes to the observed autocatalytic behavior.

20235 **Process for producing hydrogen from water using cobalt and barium compounds.** Bamberger, C.E.; Richardson, D.M. (to Dept. of Energy). US Patent 4,180,555. 25 Dec 1979. Filed date 17 Aug 1978. 6p.

PAT-APPL-934,768.

A thermochemical process for producing hydrogen comprises the step of reacting CoO with BaO or $Ba(OH)_2$ in the presence of steam of produce H_2 and novel double oxides of Ba and Co having the empirical formulas $BeCoO_{2.33}$ and $Ba_3CoO_{3.33}$. The double oxide can be reacted with H_2O to form Co_3O_4 and $Ba(OH)_2$ which can be recycled to the original reaction. The Co_3O_4 is converted to CoO by either of two procedures. In one embodiment Co_3O_4 is heated, preferably in steam, to form CoO. In another embodiment Co_3O_4 is reacted with aqueous HCl solution to produce $CoCl_2$ and Cl_2. The $CoCl_2$ is reacted with H_2O to form CoO and HCl and the CoO is recycled to the initial reaction step. The Cl_2 can be reacted with H_2O to produce HCl. HCl can be recycled for reaction with Co_3O_4. 8 claims.

20236 **Hydrogen production from water using copper and barium hydroxide.** Bamberger, C.E.; Richardson, D.M. (to Dept. of Energy). US Patent 4,169,884. 2 Oct 1979. Filed date 17 Aug 1978. 6p.

PAT-APPL-934,664.

A process for producing hydrogen comprises the step of reacting metallic Cu with $Ba(OH)_2$ in the presence of steam of produce hydrogen and $BaCu_2O_2$. The $BaCu_2O_2$ is reacted with H_2O to form Cu_2O and a $Ba(OH)_2$ product for recycle to the initial reaction step. Cu can be obtained from the Cu_2O product by several methods. In one embodiment the Cu_2O is reacted with HF solution to provide CuF_2 and Cu. The CuF_2 is reacted with H_2O to provide CuO and HF. CuO is decomposed to Cu_2O and O_2. The HF, Cu and Cu_2O are recycled. In another embodiment the Cu_2O is reacted with aqueous H_2SO_4 solution to provide $CuSO_4$ solution and Cu. The $CuSO_4$ is decomposed to CuO and SO_3. The CuO is decomposed to form Cu_2O and O_2. The SO_3 is dissolved to form H_2SO_4. H_2SO_4, Cu and Cu_2O are recycled. In another embodiment Cu_2O is decomposed electrolytically to Cu and O_2. In another aspect of the invention, Cu is recovered from CuO by the steps of decomposing CuO to Cu_2O and O_2, reacting the Cu_2O with aqueous HF solution to produce Cu and CuF_2, reacting the CuF_2 with H_2O to form CuO and HF, and recycling the CuO and HF to previous reaction steps. 7 claims.

COAL GASIFICATION

REFER ALSO TO CITATION(S) 19964

STORAGE

CHEMISORPTION

20237 (CONF-791108—23) **Modeling and evaluation of transport in solid hydrogen storage beds.** Fisher, P.W.; Watson, J.S. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 14p. Dep. NTIS, PC A02/MF A01.

From 72. AICHE meeting; San Francisco, CA, USA (25 Nov 1979).

Mathematical models have been developed to predict heat and mass transport in hydride-forming metal beds. Models are compared with experimental data (from Brookhaven National Laboratory) for a cylindrical bed containing FeTi alloy. All qualitative aspects of the data are predicted by an equilibrium model; however, more sophisticated models are required to obtain quantitative agreement.

20238 (DOE/CS/0016—T1) **Lightweight metal hydrides materials development. Final report.** (Air Products and Chemicals, Inc., Allentown, PA (USA)). Apr 1980. Contract EY-76-C-02-0016. 42p. Dep. NTIS, PC A03/MF A01.

On the basis of thermodynamic considerations Mg_2Al_3 has been identified to be a good candidate for automotive hydrogen fuel storage. However, the kinetics of the alloy/hydrogen reaction are slow. In order to understand further the phenomena associated with the slow kinetics, a four-month program was initiated with the following objectives: (1) to define the products of the hydriding reaction of the Mg_2Al_3/H_2 system (Phase I), and (2) to explore the roles and functions of Ni as a catalyst for hydriding the Mg_2Al_3 system (Phase II). Phase I results indicated that the hydrided alloy rearranges to form pockets of MgH_2 and Al; no ternary hydride was formed. Using another experimental procedure, additional evidence was obtained to support our hypothesis that the disproportionation of Mg_2Al_3 may be the rate-limiting step for the hydrogen absorption reaction. In Phase II three forms of Ni incorporation were considered: (1) Ni-platings on Mg_2Al_3 (Ni-plated samples), (2) the alloying of Ni with Mg_2Al_3 (Ni-alloyed samples), and (3) admixtures of Ni powder and Mg_2Al_3 (Ni-powder samples). The data showed that Ni, in the forms studied, does not significantly increase the rate of hydrogen absorption for the Mg_2Al_3/Ni systems. However, Ni does enhance the rate of hydrogen desorption, suggesting there are different rate-limiting steps for absorption and desorption. In addition, the form of Ni affects the rate of desorption. The data also suggests that surface morphology and particle size are important. As a result of this four month program, we have developed greater insight into the possible roles of surface morphology and Ni catalysis for the Mg_2Al_3/H_2 system. Our results suggest that further work in the area of Ni-catalysis is warranted to increase the odds of developing a workable, light-weight, hydride system exhibiting attractive desorption kinetics.

PROPERTIES

20239 (SERI/TP—31-248(Vol.2)(Pt.2), pp 477-481) **Hydrogen problems in electrochemical and fuel storage.** Thompson, A.W. (Carnegie-Mellon Univ., Pittsburgh, PA). Oct 1979.

From Reliability of materials for solar energy workshop; Denver, CO, USA (18 Dec 1978).

OTHER SYNTHETIC AND NATURAL FUELS

PREPARATION

CHEMICAL SYNTHESIS

20240 **Gas oil becomes feedstock for SNG plant.** Tao, J.C.; Klosek, J. (Air Prod and Chem, Inc). *Chem. Eng. (N.Y.);* **86**: No. 21, 70-71(8 Oct 1979).

Existing SNG plants in the U.S. are based on catalytic processes that require a low-sulfur, light-naphtha feedstock. But the policy of the federal government, as administered by the Dept. of Energy (DOE) is to preserve such light-petroleum fractions for use as chemical feedstocks. Air Products and Chemicals, Inc. (Allentown, Pa.) has applied British Gas Corp.'s Gas Recycle Hydrogenator (GRH) technology to produce substitute natural gas from high-sulfur gas oil--a lower-cost feedstock that is not allocated by DOE. In contrast to catalytic processes, GRH is a thermal route in which oil reacts with hydrogen to form gas and aromatics. Since GRH depends solely on temperature and pressure, it can tolerate heavier, high-sulfur feeds that are detrimental to catalysts. Some details of the process are given; it can be either integrated with a refinery or used by itself.

PREPARATION FROM WASTES OR BIOMASS

REFER ALSO TO CITATION(S) 20325, 20326, 20327, 20354

20241 (FE—2756-T1) **Treatment of phenolic wastewater with anaerobic-activated carbon filters. Technical completion report, September 1977-September 1979.** Suidan, M.T.; Cross, W.H.; Khan, K. (Georgia Inst. of Tech., Atlanta (USA). School of Civil Engineering). Oct 1979. Contract EF-77-G-01-2756. 234p. Dep. NTIS, PC A11/MF A01.

The research reported herein involved the development of an effective and energy efficient process for the treatment of phenol bearing wastewaters. This process consists of an anaerobic filter containing granular activated carbon as a contact medium which serves the purpose of microbial attachment and substrate concentration and polarization. The anaerobic activated carbon filter was found to be very effective in treating synthetic wastewaters containing only phenol or glucose as the carbon source or a synthetic wastewater containing both glucose and phenol. In all instances, steady state operation was achieved and removal efficiencies exceeding 96, 98, and 100 percent were obtained for total organic carbon, chemical oxygen demand and phenol where applicable, respectively. In addition the system proved to be stable to varying feed concentrations of phenol. Granular activated carbon proved to be a superior contact medium than an equivalent sized anthracite medium. The granular carbon system resulted in greater organic carbon removal and greater methane gas production.

20242 (SERI/TP—333-507) **Integrated solar receiver/biomass gasifier research.** Benham, C.; Bergeron, P.; Bessler, G.; Bohn, M. (Solar Energy Research Inst., Golden, CO (USA)). Nov 1979. Contract EG-77-C-01-4042. 9p. (CONF-791143—6). Dep. NTIS, PC A02/MF A01.

From Users Association solar fuels workshop; Albuquerque, NM, USA (28 Nov 1979).

Processes for producing liquid fuels from olefin-rich pyrolysis gases obtained from fast pyrolysis of biomass are being developed by J. Kuester at Arizona State University and J. Diebold at the Naval Weapons Center, China Lake, Calif. In the Diebold process the biomass, carried by steam, is blown through an entrained bed gasifier. The olefins are then separated from the rest of the reaction products and polymerized thermally to gasoline; the other gases are used as fuel for the process. The Kuester process uses a fluidized bed gasifier and a catalytic Fischer-Tropsch reactor which converts the olefins, hydrogen, and carbon monoxide into n-propanol and paraffinic hydrocarbons. The advantages over the Diebold process are shorter residence time and elimination of the gas separation requirement. One disadvantage is the low octane rating of the fuel. As part of the solar thermal program at the Solar Energy Research Institute (SERI), an entrained bed reactor/receiver for fast pyrolysis of biomass is being developed for use with either the Diebold or Kuester process. This system is discussed.

20243 **Anaerobic sludge digestion in the presence of lactobacillus additive.** Ghosh, S.; Klass, D.L. Chicago, IL; Institute of Gas Technology (1980). 24p. (CONF-800129—3).

From Energy from biomass and wastes 4 symposium; Lake Buena Vista, FL, USA (21 Jan 1980).

A laboratory evaluation of a lactobacillus fermentation product was performed to study its effects as an additive on the anaerobic digestion of sewage sludge under conventional and overloaded high-rate conditions. The overloaded conditions were those experienced in commercial municipal digesters. It was concluded from this work that the use of the additive at low concentrations permits digester operation at least up to double the loading of untreated digesters and at higher methane yields and volatile solids reductions without affecting effluent quality. The additive also imparts iproved digester stability and rapid response to loading rate and detention time excursions and upsets. The beneficial effets of the additive observed in the laboratory remain to be established with other feeds such as biomass, and in large-scale commercial digestion tests that are now in progress.

20244 **Engineering and economic aspects of farm digesters.** Sievers, D.M.; Fischer, J.R.; Meador, N.F.; Fulhage, C.D.; Shanklin, M.D. St. Joseph, MI; American Society of Agricultural Engineers (1975). 12p. (CONF-751262—2).

From American Society of Agricultural Engineers winter meeting; Chicago, IL, USA (15 Dec 1975).

Portions of document are illegible.

The selection of equipment and plan of operation for an anaerobic digester used in conjunction with a flushing system is described. The objectives of the study are: to build a form size anaerobid digester using on the shelf materials, to gain practical

knowledge concerning management problems associated with such a limit.

ALCOHOL FUELS

REFER ALSO TO CITATION(S) 20862

20245 (FE—2416-44(Vol.1)) **Aspects of commercializing coal-derived methanol fuels in the United States, 1985 to 2000. Volume I. Market evaluation.** (Badger Plants, Inc., Cambridge, MA (USA)). Mar 1980. Contract EX-76-C-01-2416. 173p. Dep. NTIS, PC A08/MF A01.

The objective of this program is to evaluate aspects of commercializing methanol fuel and synthetic gasoline in the United States during the period 1985 to 2000. The prospects for coal-derived fuels are evaluated only for those segments of the electric utility and automotive sectors considered most likely to provide markets for such fuels in the near term: simple-cycle peaking gas turbines and passenger vehicles, including government-owned fleet vehicles. The commitment of the electric utility industry to the use of methanol as a peakload turbine fuel is predicated upon both future price and supply. Should methanol be available in adequate and reliable amounts at a competitive price, the utility industry estimates that 75 to 100 percent of peak power turbines may eventually be converted to its use. Generally, it was concluded that methanol appears to be an acceptable replacement gas turbine fuel and that the technical problems should be readily solvable. The three major producers of automobiles in the United States gave their opinions on the commercialization of methanol as an automotive fuel. Sufficient research and development work on methanol-fueled engines has been completed, and the lead times to produce these engines will be less than the time required to construct facilities capable of providing an adequate and reliable supply of methanol. The industry methanol-derived gasoline over both neat methanol and methanol blends, as it avoids engine modification and distribution problems. Although neat methanol is favored over methanol/gasoline blends, blends would be introduced initially as a result of the present consumer acceptance of gasohol. The consensus of the financial sector is that certain incentives should be guaranteed to the private sector if the Government is to make a long-term commitment to synthetic fuel development.

20246 (FE—2416-44(Vol.2)) **Aspects of commercializing coal-derived methanol fuels in the United States, 1985 to 2000.** (Badger Plants, Inc., Cambridge, MA (USA)). Mar 1980. Contract EX-76-C-01-2416. 231p. Dep. NTIS, PC A11/MF A01.

PROPERTIES

20247 (ORNL/MIT—298) **Separation of water-ethanol mixtures by sorption.** Schumacher, W.A.; Hwa, V.W.S. (Massachusetts Inst. of Tech., Oak Ridge, TN (USA). School of Chemical Engineering Practice). Jan 1980. Contract W-7405-ENG-26. 16p. Dep. NTIS, PC A02/MF A01.

An experimental investigation was performed which examined sorption as a means for recovering anhydrous ethanol from water-ethanol mixtures. Adsorption isotherms were obtained at ambient temperature for two sorbents: a styrene-divinylbenzene copolymer manufactured by Rohm & Haas (Amberlite XAD-4) and Linde molecular sieve (No. 4966-77). Both sorbents appeared to reach a saturation level of ethanol on the sorbent for the range of ethanol concentration considered (0 to 12 wt % ethanol). The Linde sieve was more effective than the Rohm & Haas copolymer for the removal of ethanol from dilute solutions.

PREPARATION

CHEMICAL SYNTHESIS

20248 (DOE/ET/14858—T1) **Development of alcohol-based synthetic transportation fuels from coal-derived synthesis gases. First quarterly progress report, September 14-December 31, 1979.** (Chem Systems, Inc., Fairfield, NJ (USA)). 8 Apr 1980. Contract AC22-79ET14858. 68p. Dep. NTIS, PC A04/MF A01.

Chem Systems is carrying out an experimental program for the conversion of coal-derived synthesis gases to a mixture of C_1-C_4 alcohols. The objectives of this contract are to: (1) develop a catalyst and reactor system for producing a mixture of C_1-C_4 alcohols, which we call Alkanol fuel, to be used as a synthetic transportation fuel and (2) assess the technical and economic feasibility of scaling the process concept to a commercial-scale application. Some of the accomplishments made this quarter were: (1) a small (75cc) fixed-bed, plug-flow, vapor phase reaction system was set up and operated utilizing catalyst bed dilution with inert media to help limit the large exotherm associated with the synthesis gas conversion reactions; (2) a total of fifteen (15) catalysts containing varying amounts of Cu, Co, Zn, Cr and K were prepared and seven of these catalysts were tested; (3) we have identified at least one promising catalyst composition which has resulted in a 30% conversion of carbon monoxide per pass (synthesis gas had a 3.5 H_2/CO ratio) with a carbon selectivity to alcohols of about 80%.

20249 (EPRI-AF—1291) **Liquid-phase methanol. Final report.** Sherwin, M.; Blum, D. (Chem Systems, Inc., Fairfield, NJ (USA)). Dec 1979. 245p. Dep. NTIS, PC A11/MF A01.

This report is the final report in the RP317 series. This project dealt with the development of the Liquid-Phase Methanol Reactor. The concept of this reactor involves carrying out the synthesis of methanol in an ebullated bed of catalyst in the presence of an inert liquid heat carrier. Work was carried out on laboratory, continuous bench-scale, and a process development unit. Previous reports on this project included AF202 and AF693.

PREPARATION FROM WASTES OR BIOMASS

REFER ALSO TO CITATION(S) 20247, 20320, 20321, 20325

SOLID WASTE FUELS

REFER ALSO TO CITATION(S) 20317

HYDRO ENERGY

RESOURCES AND AVAILABILITY

20250 **Wainiele hydropower study.** Honolulu, HI; Dept. of Land and Natural Resources (1978). 267p.

Engineering and economic investigations were undertaken to test the feasibility of a multi-purpose dam in the Wailua River basin in Hawaii. Maximum practical hydroelectric energy generation, irrigation and domestic water supply, recreation, and flood control were examined. Results indicate that the economic outlook for such a project is not favorable at this time. The tasks - the data availability, assumptions made, and analytical techniques used - are presented in detail. The organization that was used to accomplish this conclusion consisted of: initial work identifying the maximum quantity of water that might be used for each prospective function and establishing the monetary value of that use; evaluating the performance of alternative dam developments and identifying the optimal dam site; and evaluating the optimal site in detail. A final section illustrates the economic prospects if different circumstances existed and if a different approach to evaluate the project had been taken.

SITE GEOLOGY AND METEOROLOGY

REFER ALSO TO CITATION(S) 20250

REGULATIONS AND LICENSING

20251 (PB—80-103948) **Hydro for the eighties: bringing hydroelectric power to low income people, the workbook. A slide presentation--audio cassette and workbook.** (International Science and Technology Inst., Inc., Washington, DC (USA)). Sep 1979. Contract CSA-B9AA-007. 44p. NTIS, PC A03/MF A01.

The workbook presents the rationale for developing low-cost hydroelectric power. Simplified descriptions of techniques for use by community groups to evaluate prospects for small hydro development are given. The pre-feasibility or reconnaissance stage is presented in a step-by-step form. Feasibility studies, licensing and financing procedures are outlined with guidelines identified.

SOLAR ENERGY

20252 (CONF-781235—P1) **Solar energy and conservation symposium-workshop. Proceedings of condensed papers.** Veziroglu, T.N. (ed.). (Miami Univ., Coral Gables, FL (USA). Clean Energy Research Inst.). 1978. Contract AC01-79CS30014. 328p. Dep. NTIS, PC A15/MF A01.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

A separate record was prepared for each of the condensed papers presented at the conference. (RCK)

20253 (EPRI-ER—1299-SR) **Electric utility solar energy activities: 1979 survey.** Furness, R. (Electric Power Research Inst., Palo Alto, CA (USA)). Dec 1979. 217p. Dep. NTIS, PC A10/MF A01.

The results of a survey to determine the scope of solar energy projects sponsored by electric utilities in the United States are presented. It contains brief descriptions of 735 projects being conducted by 180 utility companies. Also included are an index of projects by category, a statistical summary, a list of participating utilities with information contacts and addresses, a list of utilities with projects designated by category, a list of utilities organized by state, and a list of available reports on utility-sponsored projects.

20254 (ORO—5362-T1) **Solar energy for buildings handbook.** Christensen, D.L. (Alabama Univ., Huntsville (USA). Kenneth E. Johnson Environmental and Energy Center). Oct 1979. Contract EG-77-S-05-5362. 268p. Dep. NTIS, PC A12/MF A01.

This handbook contains presentation materials and supporting text suitable for presentations, education, short courses, etc., for general audiences, as well as government officials and members of the building trade. The following are discussed: conservation, solar energy, economics, obstructions, and the future. (MHR)

20255 (SERI/SP—401-516) **National solar energy education directory. Second edition.** Corcoleotes, G.; Cronin, S.; Kramer, K.; O'Connor, K. (Solar Energy Research Inst., Golden, CO (USA)). Jan 1980. Contract EG-77-C-01-4042. 206p. Dep. NTIS, PC A10/MF A01.

The information contained in this directory is derived from responses to a national survey of educational institutions and organizations involved in solar energy educational activities beyond the secondary school level. Phone calls and follow-up mail requests were used to gather additional information when necessary. Every survey instrument was read, coded, and edited before entry into the data base from which this directory was produced. The Directory is organized alphabetically by state. Institutions and organizations within each state are categorized according to type (Colleges and Universities, Junior/Community Colleges, Vocational/Technical Schools, and Other Educational Institutions and Organizations) and listed alphabetically within these categories. Within each institutional listing the amount of information provided will vary according to the completeness of the survey response received from that institution. (MHR)

20256 (SERI/TP—351-431) **Systems simulation and economic analysis.** (Solar Energy Research Inst., Golden, CO (USA)). 1980. Contract EG-77-C-01-4042. 502p. (CONF-800101—). Dep. NTIS, PC A22/MF A01.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

Separate abstracts were prepared for the 58 papers presented. (WHK)

20257 (SERI/TP—351-431, pp 143-147) **Solar models data base.** Kramer, K.A. (Solar Energy Research Inst., Golden, CO). 1980.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

The Solar Energy Information Data Bank (SEIDB) of the solar Energy Research Institute (SERI) has undertaken the identification and classification of models and simulations used in solar energy applications. At the present time, there is no central resource for descriptions of the variety of programs which are available. By spring of 1980, the SEIDB will have more than 170 descriptions of solar models and simulations stored in a computer and searchable online. This Models Data Base contains descriptions of models with wind, active solar heating and cooling, photovoltaics, solar thermal, biomass, passive solar, and ocean systems applications and technologies. The functions of the models range from optimizing the size of solar collectors to monitoring the response of an OTEC plant platform to ocean waves. The individual models described in the data base represent varying stages of development and levels of users. Models available for single runs to the general public are described, as are models which require sophisticated programming and which are used for complex research applications. Each record in the data base describes one solar model in three sections: background information, technical descriptions, and computer information.

20258 (SERI/TP—31-248(Vol.2)(Pt.1), pp 3-12) **SERI's research and development program.** Grosskreutz, C. (Solar Energy Research Inst., Golden, CO). Oct 1979.

From Reliability of materials for solar energy workshop; Denver, CO, USA (18 Dec 1978).

20259 (SERI/TP—31-248(Vol.2)(Pt.2)) **Reliability of materials for solar energy: workshop proceedings.** (Solar Energy Research Inst., Golden, CO (USA)). Oct 1979. Contract EG-77-C-01-4042. 670p. (CONF-781228—(Vol.2)(Pt.2)). Dep. NTIS, PC A99/MF A01.

From Reliability of materials for solar energy workshop; Denver, CO, USA (18 Dec 1978).

The 41 papers were entered in the data base separately. (WHK)

RESOURCES AND AVAILABILITY

REFER ALSO TO CITATION(S) 20524

20260 (AD-A—072986) **Investigation of the interrelationship between direct, diffuse, and total solar radiation. Special report.** Walton, G. (Army Construction Engineering Research Lab., Champaign, IL (USA)). Jul 1979. 25p. NTIS, PC A02/MF A01.

This report describes an investigation of the relationship between total solar radiation on a horizontal surface and its direct and diffuse components. It is based on radiation measurements taken in Champaign, IL, in 1978. Good agreement was found between the observed data and the SOLMET correlation, which was published after this study was begun. This report recommends use of the SOLMET correlation for solar simulation programs.

20261 (ALO—5336-T1) **Calibration of solar radiation measuring instruments. Final report.** Bahm, R.J.; Nakos, J.C. (New Mexico Univ., Albuquerque (USA). Bureau of Engineering Research). Nov 1979. Contract EM-78-S-04-5336. 237p. Dep. NTIS, PC A11/MF A01.

A review of solar radiation measurement of instruments and some types of errors is given; and procedures for calibrating solar radiation measuring instruments are detailed. An appendix contains a description of various agencies who perform calibration of solar instruments and a description of the methods they used at the time this report was prepared. (WHK)

20262 (SERI/TP—351-431, pp 337-341) **Comparative study of the TRY and TMY meteorological data.** Anderson, J.; Madison, D. (Solar Energy Research Inst., Golden, CO). 1980.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

This study compares the data for 20 sites common to the Test Reference Year (TRY) and Typical Meteorological Year (TMY) data sets. The TRY and TMY data was compared in terms of eight statistics that are important in determining heating and cooling loads in buildings and solar systems performance. The eight statistics include average dry-bulb and dew-point temperatures, heating and cooling degree-days, humidity ratio, and average insolation values. For most locations the average dry-bulb temperatures agreed fairly well. The heating and cooling degree-day values also were close, with standard deviations less than 10% of typical values. However, the statistics relating to ambient humidity did not agree, and the insolation values generated from the TRY data (with the ASHRAE/DOE-2 algorithm) were quite different from the TMY values. Overall, the TRY and TMY data sets are not interchangeable over a wide range of simulation problems.

20263 (SERI/TP—351-431, pp 485-487) **Graphical climate displays.** Bahm, R.J. (Bickle/CM, Albuquerque, NM). 1980.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

The 3-dimensional displays provide a simple, rapid method of characterizing the climate at a location. These displays provide qualitative information on the performance which might be expected from particular types of solar space heating systems and can be used to aid in preliminary decisions of solar space heating systems and other mechanical and architectural designs.

20264 (SOLAR/0010—78/09) **September 1978 environmental data for sites in the National Solar Data Network.** (International Business Machines Corp., Huntsville, AL (USA). Federal Systems Div.). Sep 1978. Contract EG-77-C-01-4949. 148p. Dep. NTIS, PC A07/MF A01.

The temperature data most often required for solar energy system studies, insolation, wind, and relative humidity are presented for over sixty demonstration program sites. (MHR)

20265 (SOLAR/0010—79/12) **Environmental data for sites in the National Solar Data Network.** (Automation Industries, Inc., Silver Spring, MD (USA). Vitro Labs. Div.). Dec 1979. Contract AC01-79CS-30027. 218p. Dep. NTIS, PC A10/MF A01.

Environmental information collected at each of the sites for the reporting month are tabulated. Data included are insolation, temperature, wind, and relative humidity. These data are for use in determining the thermal performance of the solar systems. (MHR)

20266 (SOLAR/0010—80/03) **Environmental data for sites in the National Solar Data Network.** (Automation Industries, Inc.,

Silver Spring, MD (USA). Vitro Labs. Div.). Mar 1980. Contract AC01-79CS30027. 221p. Dep. NTIS, PC A10/MF A01.

Environmental information collected at the sites for the reporting month are tabulated. Data included are insolation, temperature, wind, and relative humidity. These data are for use in determining the thermal performance of the solar systems. (MHR)

ECONOMICS

REFER ALSO TO CITATION(S) 20337, 20383, 21233

20267 (CONF-781235—P1, pp 229-230) **Graphic method for cost estimation of low thermal potential solar energy application devices for use in Egypt.** Abdelhafiez, S. (Univ. of Alexandria, Egypt). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

20268 (SERI/TP—351-431, pp 193-198) **Economic worth of on-site solar electric generation in a utility grid.** Gupta, Y.; Knowles, R.; Merrill, O.; Young, S. (Science Applications, Inc., McLean, VA). 1980.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

Widespread utilization of solar electric technologies in parallel, or as supplements to the existing utility necessitate a detailed evaluation of their economic worth and utility impacts. Such an assessment must be performed within the context of the overall utility/solar electric system interaction system design-cost relations, future electric energy costs, rate structures, and ownership options. SAI has developed a methodology to evaluate in detail the utility impacts and economics of grid-connected solar electric technologies. The value of utility integrated solar plants consists of both electric generation costs and capacity costs to meet a specified reliability level and depends on a number of complex variables. The methodology and results presented incorporate these complex variables through integration of diverse smulation techniques, including hourly solar electric system performance evaluation, probabilistic solar-subtracted load determination based on solar plant outage probabilities, mixed-integer linear programming formulation of the capacity expansion and probabilistic determination of generation cost and loss of load probabilities.

20269 (SERI/TP—351-431, pp 199-202) **Economies of scale in the acquistion of solar energy.** Dick, C.L. Jr.; Grebenstein, C.R. (Exxon Enterprises, Inc., New York, NY). 1980.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

The recent hypothesis that there are no economies of scale in the acquisition of solar energy is explored. A non-technical definition of the concept of economies of scale is offered as well as three examples of the use of this concept in real world situations. First, a study is cited which maintains that economies of scale existed and were exploited in US electric power generation. Second, a study is cited which indicates economies of scale exit for sugarcane farmers where biomass conversion of sunlight is the solar energy process. Third, the optimal sizing of residential solar hot water systems is offered as an example of the use of scale concepts in solar thermal applications. The conclusions reached are that scale economies are important in policymaking, that scale economies do appear to exist in at least some solar energy applications and that further research in this area seems warranted.

20270 **Sources of state and federal funding for solar/appropriate technology activities.** Sacramento, CA; Office of Appropriate Technology (1980). 23p. Office of Appropriate Technology, Sacramento, CA.

The following sources of assistance are covered: for energy inventors, for small solar/renewable resource businesses, for solar projects (neighborhood/community, local government, commercialization), and for homeowners. (MHR)

ENVIRONMENTAL, LEGAL, AND INSTITUTIONAL ASPECTS

REFER ALSO TO CITATION(S) 20383, 20417

20271 (AED-Conf—78-170-005) **Preconditions and possibilities of solar energy utilization.** Fornallaz, P. (Eidgenoessische Technische Hochschule, Zurich (Switzerland)). 1978. 21p. (In German). (CONF-7805199—1). Dep. NTIS (US Sales Only), PC A02/MF A01.

From SVA information meeting on nuclear power and alternatives as reflected in public opinion; Zurich, Switzerland (29 May 1978).

The problem of solar energy utilization is dealt with under technical, economical and ecological aspects. Based on discussion of a nation's energy needs, the conclusion is drawn that there are 5 important criteria which determine the utilization possibilities of solar energy within the framework of the overall energy supply: (1) Which secondary energies can be produced with solar energy; (2) Can the energy waste be curbed; (3) How does solar energy rate in comparison with conventional plants under aspects of rentability; (4) In connection with the utilization of solar energy, no methods are to be used which disturb the balance in the biosphere in a lasting and fatal way. In particular, those methods have to be avoided which introduce additional energy into the biosphere, the result of which are big energy shifts; and (5) Every solar plant is to produce much more useful energy than is used for its production, its operation and dismantling. The basis for the whole discussion is the energy situation in Switzerland, to which a lot of references are made.

20272 (CONF-7805162—P2) **Proceedings of solar energy consumer protection workshop. Volume two. Workshops A, B, C, & D.** (Florida Solar Energy Center, Cape Canaveral (USA)). Jan 1980. Contract EM-78-C-01-5174. 426p. Dep. NTIS, PC A19/MF A01.

From Solar Energy Consumer Energy workshop; Atlanta, GA, USA (3 May 1978).

Edited discussions from four individual workshops are presented. These workshops were: standards setting, testing, certification, and labeling; trade licensing laws and training programs, building codes, and consumer information and education. (MHR)

SOLAR ENERGY CONVERSION

PHOTOVOLTAIC CONVERSION

REFER ALSO TO CITATION(S) 20334, 20431, 20702, 20939

20273 **Nondestructive method for detecting defects in photodetector and solar cell devices.** US Patent Application 042,462. [nd]. 17p.

The invention described herein is a method for locating semiconductor device defects and for measuring the internal resistance of such devices by making use of the intrinsic distributed resistance nature of the devices. The method provides for forward-biasing a solar cell or other device while it is scanning with an optical spot. The forward-biasing is achieved with either an illuminator light source or an external current source.

20274 (CONF-791103—82) **Characterization of ion implanted, laser annealed silicon for solar cell applications.** White, C.W. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 6p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

It has been demonstrated that ion implanted silicon can be efficiently annealed using very fast pulses of laser radiation. A wide variety of analytical techniques have been used to determine the physical and electrical properties of ion implanted silicon crystals which have been annealed using the output of a pulsed ruby laser (energy density $\sim 1.5\ J/cm^2$, 15×10^{-9} sec pulse duration time). Ion channeling measurements and transmission electron microscopy show that there are no extended defects remaining in the implanted region after laser annealing even when this region was made amorphous by implantation. Ion channeling measurements have been used to show that dopants occupy electrically active substitutional sites in the lattice after laser annealing even when the dopant concentration greatly exceeds the equilibrium limit of solid solubility. Results are reported. (WHK)

20275 (CONF-791112—55) **Laser processing of polycrystalline silicon solar cells.** Young, R.T.; Wood, R.F.; Narayan, J.; White, C.W. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 8p. Dep. NTIS, PC A02/MF A01.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1979).

In the formation of p-n junctions in polycrystalline solar cells, any conventional high-temperature treatment will cause adverse effects either because of dopant diffusion along the grain boundaries which may cause shorting of the junction, or because of contamination by undesired impurities. Recently, we have demonstrated that ion implantation and pulsed-laser annealing can be used to produce well-controlled dopant regions in polycrystalline Si. Because of the short duration of the laser radiation and because the near-surface region of the samples melt, grain boundary diffusion and segregation can be eliminated. Solar cells fabricated from cast polycrystalline Si by this technique have resulted in open circuit voltages as high as 560 mv and efficiencies as high as 11.6%.

20276 (DOE/ET/20562—4) **Thin-film polycrystalline silicon solar cells. Final report, September 11, 1978-September 10, 1979.**

Faughnan, B.W. (RCA Labs., Princeton, NJ (USA)). Nov 1979. Contract AC03-78ET20562. 75p. Dep. NTIS, PC A04/MF A01.

The effect of grain boundaries on the performance of solar cells fabricated on Wacker Silso polycrystalline silicon substrates has been studied. Efficiencies of 8% (no AR coating) were obtained (11.2% with AR coating). This is 20% lower than the efficiency obtained for identically fabricated single-crystal cells. This reduction can be accounted for as follows: 4% reduction in V/sub oc/ due to grain boundaries, 8% reduction in J/sub sc/ due to grain boundaries, and 8% reduction in J/sub sc/ due to a lower minority carrier diffusion length inside the grains. Quantum efficiency measurements were made with a 150-μm-diameter light spot inside grains and across grain boundaries, permitting a determination of L/sub n/ inside a grain (L/sub n/ = 75 μm for Wacker Silso). Laser scans were obtained at $\lambda = 0.633$ μm and at $\lambda = 1.15$ μm. Some grain boundaries are shown to be electrically inactive. Active grain boundaries were also observed by a novel liquid-crystal technique. Deep traps were studied by DLTS. The crystallographic orientation of individual grains was measured by an SEM technique called electron channeling patterns. Two silicon bicrystals were grown with well defined grain boundaries [(111) growth directions, 30° and 5° misorientation between the (110) directions].

20277 (DOE/ET/23002—T7) **Polyacetylene, (CH)/sub x/, as an emerging material for solar cell applications. Technical progress report, October, November, December 1979.** Heeger, A.J.; MacDiarmid, A.G. (Pennsylvania Univ., Philadelphia (USA)). 14 Feb 1980. Contract AC04-79ET23002. 26p. Dep. NTIS, PC A03/MF A01.

Initial studies of p-n heterojunctions formed between undoped trans-(CH)/sub x/ and n-CdS are reported. The junctions were characterized by measurements of current vs voltage (I-V), capacitance vs voltage (C-V), and photovoltaic response spectra. The results are analyzed in terms of the standard heterojunction equations. It is concluded that undoped as-grown films of trans-(CH)/sub x/ are p-type with a residual acceptor concentration of 2×10^{18} cm^{-3}, and that in spite of the complex fibril morphology the semiconductor properties can be inferred by treating (CH)/sub x/ as an effective homogeneous medium. Detailed studies of the photovoltaic response at energies below the energy gap for (CH)/sub x/ imply the existence of a well-defined deep trapping state in polyacetylene with an energy near the center of the gap.

20278 (DOE/ET/23005—T3) **Emerging materials systems for solar cell applications: Cu/sub 2-x/Se. Third quarterly technical progress report, November 1, 1979-February 1, 1980.** Mickelsen, R.A.; Stewart, J.M.; Chen, W.S. (Boeing Aerospace Co., Seattle, WA (USA)). Feb 1980. Contract AC04-79ET23005. 17p. Dep. NTIS, PC A02/MF A01.

The purpose of this program is to investigate the feasibility of using Cu/sub 2-x/Se as a semiconductor material for the low cost production of photovoltaic solar cells. The Cu/sub 2-x/Se films are produced by coevaporation from individually monitored Cu and Se vapor sources. With a substrate temperature of 170°C, single phase cubic Cu/sub 2-x/Se films have been produced. These films have a direct band gap of 2.2 eV and an indirect band gap of 1.4 eV. Fabrication of Cu/sub 2-x/Se/CdS cells has begun. Both front wall and back wall cells have been made. A theoretical computation on the thin-film Cu/sub 2-x/Se/CdS cell has indicated an achievable efficiency of greater than 10%.

20279 (DOE/JPL—1012-19) **Silicon preparation and purity from the reaction of sodium with silicon tetrafluoride and silicon tetrachloride: a thermochemical study.** Rhein, R.A. (Jet Propulsion Lab., Pasadena, CA (USA)). 15 Apr 1979. Contract EX-76-A-29-1012. 49p. Dep. NTIS, PC A03/MF A01.

Thermochemical equilibrium computations for the preparation of silicon (Si) by the reaction between sodium (Na), either liquid or vapor, with silicon tetrafluoride (SiF_4) and silicon tetrachloride ($SiCl_4$) are presented. Computations indicate that SiF_4 reacts with either liquid or gaseous Na to produce temperatures sufficiently high to form molten Si. Liquid Na reacts with SiF_4 to produce substantially higher Si yields than does the free combustion reaction with Na vapor; however, the Na vapor/SiF_4 reaction, if temperature-constrained at the Si melting point, produces an expected Si yield close to 100%. A stoichiometric mixture of liquid Na and $SiCl_4$ vapor reacts to produce liquid Si, gaseous sodium chloride (NaCl), and a small concentration of Si subhalides. Gaseous Na, however, reacts with $SiCl_4$ to form entirely gaseous reaction products and a high yield of Si (liquid) but subhalide concentrations are greater than when liquid Na is used. The reactions of a number of impurity elements in Na, during the course of the Na-Si halide reaction, have been described. Of those considered, only calcium (Ca), magnesium (Mg), phosphorus (P), and strontium (Sr) are expected to co-exist to any extent in Na vapor and none is expected to be in the Si products if excess Si halide is used in the Na-Si halide reactions.

20280 (DOE/JPL/954527—12) **Investigation of test methods, material properties, and processes for solar cell encapsulants. Encapsulation task of the Low-Cost Silicon Solar Array project. Thirteenth quarterly progress report, May 12, 1979-August 12, 1979.** (Springborn Labs., Inc., Enfield, CT (USA)). Jan 1980. Contract NAS-7-100-954527. 35p. Dep. NTIS, PC A03/MF A01.

Springborn Laboratories is engaged in a study of evaluating potentially useful encapsulating materials for Task 3 of the Low-Cost Silicon Solar Array project (LSA) funded by DOE. The goal of this program is to identify, evaluate, and recommend encapsulant materials and processes for the product of cost-effective, long-life solar cell modules. Current technical activities are directed primarily towards the development of a solar module encapsulation technology that employs ethylene/vinyl acetate copolymer as the pottant. Due to the surface tack of EVA, a slip sheet of release paper is required between each layer to prevent the plies from adhering. Manufacturers were surveyed and a source for inexpensive release paper in roll form was identified. A survey of separator materials was also conducted. Corrosion studies using a standard salt spray test were used to determine the degree of protection offered to a variety of metals by encapsulation in EVA pottant. Due to the low surface hardness of EVA and the remaining sensitivity to ultraviolet light, outer covers are required to prevent soiling and improve the weatherability. Two candidate films (Korad 212 and Tedlar UT) have been identified for this function. These films are somewhat scratch and abrasion sensitive, however, and their useful life can be prolonged with the application of thin layers of abrasion resistant hard coats. A survey of manufacturers of these coatings was performed and the products compared. Field trials of outdoor performance must be performed to fully assess the durability of these coatings.

20281 (DOE/JPL/954527—80/13) **Investigation of test methods, material properties, and processes for solar cell encapsulants. Fourteenth quarterly progress report, August 12, 1978-November 12, 1979.** Willis, P.B.; Baum, B.; Schnitzer, H.S. (Springborn Labs., Inc., Enfield, CT (USA)). Dec 1979. Contract NAS-7-100-954527. 90p. Dep. NTIS, PC A05/MF A01.

Springborn Laboratories is engaged in a study of evaluating potentially useful encapsulating materials for Task 3 of the Low-Cost Silicon Solar Array project (LSA) funded by DOE. The goal of this program is to identify, evaluate, and recommend encapsulant materials and processes for the production of cost-effective, long-life solar cell modules. This report presents the results of a cost analysis of candidate potting compounds for long life solar module encapsulation. Additionally, the two major encapsulation processes, sheet lamination and liquid casting, are costed on the basis of a large scale production facility. Potting compounds studied include EVA, sheet, clear; EVA, sheet, pigmented; EPDM, sheet, clear; Aliphatic urethane, syrup; PVC Plastisol; Butyl acrylate, syrup; and Butyl acrylate, sheet.

20282 (DOE/JPL/954654—80/10) **Low Cost Solar Array Project: large area silicon sheet task. Silicon web process development. Quarterly report, October 1-December 31, 1979.** Duncan, C.S.; Seidensticker, R.; Hopkins, R.H.; McHugh, J.P.; Hill, F.E.; Skutch, M.E.; Driggers, J.M. (Westinghouse Research and Development Center, Pittsburgh, PA (USA)). 1979. Contract NAS-7-100-954654. 74p. Dep. NTIS, PC A04/MF A01.

Silicon dendritic web is a ribbon form of silicon which grows directly from the melt without dies and can produce solar cells with AM1 conversion efficiency over 15%. The primary objective of this program is to develop the technology to produce silicon web at a cost compatible with the national goal of 50 cents per peak watt (70 cents per watt in 1980$) of photovoltaic output power. During the period covered by this report the dominant activities were directed at developing methods to increase the period of simultaneous growth of web crystal with melt replenishment. To further this work, an adjustable thermal trimmer to dynamically balance the thermal loads during melt replenishment was designed and tested. The highlights of the concept and initial tests are described. Further studies of growth geometries to enhance web output rate were performed, the economic analysis for web growth was performed, and a potentially lower cost solid state power supply for the growth furnace was tested. Results are reported. (WHK)

20283 (DOE/JPL/954847—79/6) **Phase 2 of the automated array assembly task of the Low-Cost Silicon Solar Array Project. Technical quarterly report No. 5, July 1-September 30, 1979.** Coleman, M.G.; Pryor, R.A.; Sparks, T.G. (Motorola, Inc., Phoenix, AZ (USA). Semiconductor Group). 1979. Contract NAS-7-100-954847. 33p. Dep. NTIS, PC A02/MF A01.

Ion implantation, metallization, and plasma pattern etching of silicon nitride tasks are highlighted. Experiments were performed to evaluate solar cells formed by simulated unanalyzed beam ion implantation, comparing these cells with analyzed beam implanted cells. Plasma patterning of silicon nitride with mechanical masks has been improved, primarily through equipment modifications. Finally, nickel and copper plating have been performed on solar cells, demonstrating feasibility of this base-metal system. The contract has been modified to delay the plasma silicon and texturing etching efforts to the next quarter.

20284 (DOE/JPL/954854—80/5) **Phase 2 of the array automated assembly task for the low cost silicon solar array project. Fifth quarterly report.** Petersen, R.C.; Anderson, J.R. (Solarex Corp., Rockville, MD (USA)). Jan 1980. Contract NAS-7-100-954854. 43p. Dep. NTIS, PC A03/MF A01.

This program focuses attention on one key step of a proposed process sequence for mass production of inexpensive silicon solar arrays for terrestrial use. The process step of concern is the metallization of the solar cell. Solarex has proposed that the metallization be accomplished by a single electroless plating of nickel followed by a dip in molten solder, and Solarex manufactures solar cells using this procedure. ing, cleaning and annealing. Motorola has recommended a process which includes the electroless nickel plate and solder dip of the Solarex process, but which precedes these steps with a number of additional steps of palladium plating, cleaning and annealing. Motorola has claimed that these additional steps are necessary to assure proper ohmic contact with the silicon while at the same time avoiding excessive nickel penetration into the silicon. This program comprises a technical comparison of the Solarex and Motorola processes. Progress is reported.

20285 (DOE/JPL/954854—80/6) **Array automated assembly task for the Low-Cost Silicon Solar Array Project, Phase 2. Sixth quarterly report.** Petersen, R.C. (Solarex Corp., Rockville, MD (USA)). Apr 1980. Contract NAS-7-100-954854. 31p. Dep. NTIS, PC A03/MF A01.

This program is concerned with nickel/solder metallization of silicon solar cells. Work in this second quarter of the program extension comprised portions of four experimental tasks. The task to study nickel plating on silicon oxide films has led to the finding that the plating solution dissolves oxide before depositing nickel. The electron microprobe study of nickel penetration of silicon has shown that sintering can be conducted for long times at 300°C but that problems may arise above this temperature, even though there is no significant penetration of nickel into silicon below about 450°C. Measurements on cells fabricated using plating times in the four to fourteen minute range indicate no degradation of cell properties as a result of contact with the plating solution in this time range, but do show evidence of poor contact quality if the nickel plate is either too thick or too thin. The task to assess the Motorola plating process is in its early stages, but it is evident that the process is a very complex and time consuming one.

20286 (DOE/JPL/954865—79/6) **Array automated assembly task. Low cost silicon solar array project. Phase 2. Quarterly technical report No. 6.** Rhee, S.S.; Allison, K.L.; Jones, G.T. (Sensor Technology, Inc., Chatsworth, CA (USA)). Jun 1979. Contract NAS-7-100-954865. 27p. Dep. NTIS, PC A03/MF A01.

Work on the add-on study of Phase 2 of the Array Automated Assembly Task was conducted during this reporting period. Three applications of the spray-on technique were investigated. The most effective spray-on boron back surface fields were produced at the drive-in temperature of 1000°C for the range of temperatures investigated. Of the three spray-on aluminum metallization techniques under consideration, two appear to be promising, and the third was shown to be unsuccessful. The smallest spray-on AR coating layer thickness available from our spray-on system at the present time was found to be 1000A. Work in the area of pulsed microwave heating for solar cell fabrication was initiated. A subcontractor was selected to develop an appropriate microwave system.

20287 (DOE/JPL/954865—79/8) **Array automated assembly task: Low-Cost Silicon Solar Array Project, Phase 2. Quarterly technical report No. 8.** Jones, G.T. (Sensor Technology, Inc., Chatsworth, CA (USA)). Dec 1979. Contract NAS-7-100-954865. 39p. Dep. NTIS, PC A03/MF A01.

Several microwave systems for use in solar cell fabrication were developed and experimentally tested this quarter. The first system used a standing wave rectangular waveguide horn applicator. Satisfactory results were achieved with this system for impedance matching and wafer surface heating uniformity. The second system utilized a resonant TM_{011} mode cylindrical cavity. This particular system cannot be employed due to its poor energy coupling efficiency. The third and fourth microwave systems utilized a circular waveguide operating in the TM_{01} mode exciting a conical horn and a circular waveguide operating in a cross-polarized TE_{11} mode exciting a conical horn respectively. Both systems have potential for producing good wafer surface heating uniformity. A fifth microwave system utilized a fringe field applicator which offers a possibility for control of the microwave energy penetration depth and would, therefore, be suitable for shallow heating. This system had difficult problems with impedance matching, efficiency and field uniformity. An alternate method for controlling the depth of wafer heating is being considered.

20288 (DOE/JPL/954868—79/8) **Automated array assembly, Phase II. Quarterly report No. 7, July 1-September 30, 1979.** D'Aiello, R.V. (RCA Labs., Princeton, NJ (USA)). Oct 1979. Contract NAS-7-100-954868. 48p. Dep. NTIS, PC A03/MF A01.

During this period, work continued on studies of three manufacturing sequences for solar cells based on ion-implanted junctions, furnace annealing, screen-printed contacts, and spray-on antireflection (AR) coatings. The starting material has been primarily solar-grade, n- and p-type 3-in.-diameter wafers; in addition, a small quantity of dendritic web has been received. A total of 1500 solar cells has been fabricated and evaluated. As a result of this work, two problems areas have not been identified relating to materials and process compatibility. First, screen-printed thick-film inks do not contact ion-implanted junctions as well as diffused junctions. Second, it was found that the previously determined optimum ion implantation/anneal process must be modified to accommodate the starting silicon material. Discounting the above compatibility problems, evaluations and comparisons of the three manufacturing sequences were made with regard to the performance data accumulated for each sequence and its effect on cost-effectiveness. In cell interconnection and panel assembly, a solder reflow process has been demonstrated in which the cells are individually tabbed and then placed in an array which is soldered by means of a bank of infrared lamps which traverse the array. With the present system, this latter process is accomplished at a rate of 1 linear ft of array/minute.

20289 (DOE/JPL/954882—80/20) **Process development for automated solar cell and module production. Task 4: automated array assembly. Quarterly report No. 5.** Hagerty, J.J. (MB Associates, San Ramon, CA (USA)). 31 Jan 1980. Contract NAS-7-100-954882. 21p. Dep. NTIS, PC A02/MF A01.

Construction of an automated solar cell layup and interconnect system is now complete. This system incorporates a Unimate 2000 B industrial robot with an end effector consisting of a vacuum pick up and induction heating coil. The robot interfaces with a smart cell preparation station which correctly orients the cell, applies solder paste and forms and positions the correct lengths of interconnect lead. The system is controlled and monitored by a TRS-80 micro computer. The first operational tests of the fully integrated station have been run. These tests proved the soundness of the basic design concept but also pointed to areas in which modifications are necessary. These modifications are nearly complete and the improved parts are being integrated. Development of the controlling computer program is progressing to both reflect these changes and reduce operating time.

20290 (DOE/JPL/954886—79/9) **LSA large area silicon sheet task: continuous liquid feed Czochralski growth. Quarterly report No. 9, October-December 1979.** Walters, D. (Siltec Corp., Menlo Park, CA (USA)). Jan 1980. Contract NAS-7-100-954886. 30p. Dep. NTIS, PC A03/MF A01.

Now nearing the end of its second phase, the purpose of this program is the design and development of equipment and processes to demonstrate the continuous growth of crystals, by use of the Czochralski method, suitable for producing monocrystalline silicon for use in solar cells. This involves the growth of at least 150 kg of monocrystalline silicon ingots, 150 mm in diameter, obtained from a single growth container. The approach to meeting this goal is to develop a furnace with continuous liquid replenishment to the growth crucible. The major objectives for the new melt transfer system were accomplished this quarter. This included a reduction in the overall dimensions of the transfer tube system in order to accommodate 150-mm diameter ingot growth from 12-inch diameter crucibles, and the design, development and fabrication of a reusable transfer tube heater. Due to a lack of available space for thermal insulation in the vertical section of the transfer tube, primarily a result of the larger rigid graphite heater and the smaller outer shell, some difficulty was experienced in achieving the proper temperature profile over the melt transfer path. Fabrication of the lump/particle feed mechanism, designed to adapt to the gate valve of the meltdown chamber, was completed and installed. This system is capable of supplying polycrystalline particles to the meltdown chamber in a continuous mode in such a manner that the average mass introduced into the meltdown chamber is in balance with the solidification rate in the growth chamber. A preliminary economic analysis, using the IPEG model, has been performed.

20291 (DOE/JPL/954888—79/8) **Continuous Czochralski growth: silicon sheet growth development of the large area silicon sheet task of the Low Cost Silicon Solar Array Project. Second annual progress report, October 1-September 30, 1979.** Lane, R.L.; Roberts, E. (Kayex Corp., Rochester, NY (USA)). 1979. Contract NAS-7-100-954888. 43p. Dep. NTIS, PC A03/MF A01.

The purpose of this program is to demonstrate the growth of at least 100 kilograms of mono crystalline ingot from one crucible by the Czochralski (CZ) method. The approach to the continuous growth process being pursued in this effort relies on conventional CZ technology combined with new equipment designs which allow repeated alternate cycles of crystal growth and hot melt replenishment by methods which are suitable for use in a high volume production facility. A Hamco Model CG2000 crystal grower was modified with a special chamber for the storage of a supply of polycrystalline silicon and a vacuum-tight isolation valve to permit

retrieval of crystals and melt replenishment without contamination. A number of additional modifications to the facility have been completed in the program, and the process study phase is now under way, with a number of multi-ingot runs having been performed. It is the purpose of this contract extension to describe a program aimed at a more accurate cost analysis of the continuous growth of silicon into material and also an investigative program for the purpose of defining and solving problems which may hinder the development of continuous Czochralski growth. Progress is reported.

20292 (DOE/JPL/954995—80/6) **Develop silicone encapsulation systems for terrestrial silicon solar arrays. Final report.** (Dow Corning Corp., Midland, MI (USA)). Dec 1979. Contract NAS-7-100-954995. 57p. Dep. NTIS, PC A04/MF A01.

This work resulted in two basic accomplishments. The first was the identification of DOW CORNING Q1-2577 as a suitable encapsulant material for use in cost effective encapsulation systems. The second was the preparation of a silicon-acrylic cover material containing a durable ultraviolet screening agent for the protection of photo-oxidatively sensitive polymers. The most expeditious method of fabrication is one in which the encapsulant material performs the combined function of adhesive, pottant, and outer cover. The costs of the encapsulant can be minimized by using it as a thin conformal coating. One encapsulation system using silicones was identified which provided protection to photovoltaic cells and survived the JPL qualification tests. This encapsulation system uses DOW CORNING Q1-2577, a conformal coating from Dow Corning, as the combined adhesive, pottant and cover material. The lowest cost encapsulation system using Q1-2577 had Super Dorlux as the substrate structural member. The overall material cost of this encapsulation system is 0.74 cents/ft^2 (1980 dollars) based on current material prices, which could decrease with increased production of Q1-2577. Subsequent to identifying the best silicone encapsulation system, a silicone acrylic cover material containing a durable ultraviolet screening agent was prepared and its effectiveness in protecting photo-oxidatively sensitive polymers was demonstrated.

20293 (DOE/JPL/955089—79/6) **Silicon solar cell process development, fabrication and analysis. Fourth quarterly report, July 1, 1979-September 30, 1979.** Yoo, H.I.; Iles, P.A.; Ho, F.F. (Optical Coating Lab., Inc., City of Industry, CA (USA). Photoelectronics Div.). 1980. Contract NAS-7-100-955089. 68p. Dep. NTIS, PC A04/MF A01.

Evaluation was performed for three sheet silicon forms: (a) continuous Czochralski growth (Varian), (b) EFG multi-ribbon (Resistance-heated), and (c) dendritic web silicon. AMO efficiencies (average) obtained were as follows: (efficiencies of control cells made from Czochralski silicon, processed alongside are in parentheses) (a) continuous Czochralski cells - 10.7% (10.9%); (b) EFG Cells: (i) Standard Process - 6.5% (~ 12%), (ii) High Efficiency Process - 8.0% (>12%), and (c) Dendritic Web (Standard Process) - 10.1% (11.2%). In addition to the illuminated performance, the usual backup measurements were made of diffusion length, spectral response, dark diode characteristics, and fine light spot scanning. Early attempts to include BSF processes to low resistivity silicon led to excessive cell shunting; work proceeds to identify the reasons.

20294 (DOE/JPL/955217—79/3) **Development of high efficiency (14%) solar cell array module. Third quarterly report, July 15, 1979-November 15, 1979.** Iles, P.A.; Khemthong, S.; Olah, S.; Sampson, W.J.; Ling, K.S. (Optical Coating Lab., Inc., City of Industry, CA (USA). Photoelectronics Div.). 1980. Contract NAS-7-100-955217. 32p. Dep. NTIS, PC A03/MF A01.

Most effort was concentrated on development of procedures to provide large area (3" diameter) high efficiency (~ 15.5% AM1, 28°C) P/N solar cells. These efficiencies had been obtained for 2 x 2 cm area cells, but tests showed that the problem was not reduced silicon quality near the edges of the larger slices. The problems were in optimizing the back-surface field (BSF) process, and its possible interaction with the shallow P+ layer formation. Towards the end of this reporting period a promising process sequence had been identified and is being tested. The module design has been finalized. One hundred and twenty (120) cells will be connected eight (8) in parallel and fifteen (15) in series. The designs and tooling phases have been completed and are awaiting completion of the cells.

20295 (DOE/JPL/955244—79/3) **Development of low cost contacts to silicon solar cells. Second quarterly report, July 15, 1979-October 15, 1979.** Tanner, D.P.; Iles, P.A. (Optical Coating Lab., Inc., City of Industry, CA (USA). Photoelectronics Div.). 1979. Contract NAS-7-100-955244. 44p. Dep. NTIS, PC A03/MF A01.

The present results of the second phase of the contract in developing low cost contacts to silicon solar cells using copper are reported. In Phase I, copper diffusion from the newly developed plated Pd-Cr-Cu contact system with heating of 400°C was shown to cause shunting problems in active solar cells. Phase II started with a literature search on reported details of copper diffusion through different metals. Nickel was shown to be the best easily plated candidate metal to serve as a barrier to the copper diffusion. A heat treatment study using evaporated metals is in progress to evaluate the results of the paper study. Thus far Pd-Ag, Cr-Ag and Pd-Cu systems have been studied. An inexpensive screenable plating mask has been found and when used with a newly developed contact pattern gave cells with good V/sub OC/, I/sub SC/ and curve fill factor.

20296 (DOE/JPL/955269—80/3) **Low cost solar array project: Task I. Silicon material. Third quarterly progress report, October 17, 1979-January 17, 1980.** Jewett, D.N.; Bates, H.E.; Hill, D.M. (Energy Materials Corp., Harvard, MA (USA)). 1980. Contract NAS-7-100-955269. 11p. (DRL—113; DRD-SE—4). Dep. NTIS, PC A02/MF A01.

During this quarterly period we have completed assembly of 95% of the power control and gas handling systems. 95% of the reaction chamber parts are made and ready to be assembled. As new problems have become apparent, we have made specific design changes and additions. Specifically, thermal expansion, quartz to graphite connections, and recycle gas flow control have posed problems that have been eliminated by design.

20297 (DOE/JPL/955307—4) **Analysis of the effects of impurities in silicon. Final report, January 19, 1979-January 31, 1980.** Wohlgemuth, J.H.; Giuliano, M.N. (Solarex Corp., Rockville, MD (USA)). 1980. Contract NAS-7-100-955307. 86p. Dep. NTIS, PC A05/MF A01.

The purpose of this program was to conduct a solar cell fabrication and analysis program to determine the effects on the resultant solar cell efficiency of impurities intentionally incorporated into silicon. The program employed flight-quality technologies and quality assurance typical of an experienced solar cell manufacturer to assure that variations in cell performance are due to the impurities incorporated in the silicon. A rigid program of documentation and decontamination procedures was instituted. Procedures and results are reported in detail. (WHK)

20298 (DOE/JPL/955339—79/3) **Anti-reflection coatings on large area glass sheets. Quarterly technical report No. 3, July 1-September 30, 1979. Motorola report No. 2366/3.** Pastirik, E. (Motorola, Inc., Phoenix, AZ (USA). Semiconductor Group). 1980. Contract NAS-7-100-955339. 15p. Dep. NTIS, PC A02/MF A01.

The ultimate goal of this project is improvement of the efficiency of photovoltaic modules through increased transmission of light by the module cover. One method of increasing transmission is by reducing the reflection of light by the module cover, a reflection which accounts for a 4% loss of transmission for each coverglass-air interface. This study is intended to advance a known antireflection technology to the point where large area glass module covers can be treated to produce uniform, efficient, and durable antireflective films. Progress is reported.

20299 (DOE/JPL/955342—79/3) **Development of Megasonic cleaning for silicon wafers. Quarterly report No. 3, September 15, 1979-December 14, 1979.** Mayer, A. (RCA Solid State Div., Somerville, NJ (USA); RCA Labs., Princeton, NJ (USA)). 1 Jan 1980. Contract NAS-7-100-955342. 20p. Dep. NTIS, PC A02/MF A01.

During this period the total Megasonic system has been operated regularly and is functioning well. The most critical missing part is the belt drive for the air-drying system; delivery of this drive is now scheduled for the end of January. Preliminary data on wafer cleaning and rinsing indicate that the design criteria of cleaning ability, ease of operation, and safety have been largely achieved. Chemicals utilization appears to be even better than anticipated.

20300 (DOE/JPL/955640—80/1) **Development and fabrication of a solar cell junction processing system. Quarterly progress report No. 1.** (Jet Propulsion Lab., Pasadena, CA (USA)). Apr 1980. Contract NAS-7-100-955640. 19p. Dep. NTIS, PC A02/MF A01.

The basic objectives of the program are the following: (1) to design, develop, construct and deliver a junction processing system which will be capable of producing solar cell junctions by means of ion implantation followed by pulsed electron beam annealing; (2) to include in the system a wafer transport mechanism capable of transferring such wafers into and out of the vacuum chamber where the ion implantation and pulsed electron beam annealing processes take place; (3) to integrate, test and demonstrate the system prior to delivery to JPL; and (4) to estimate component lifetimes and costs, as necessary for the contract, for the performance of comprehensive analyses in accordance with the solar array manufacturing industry costing standards (SAMICS). Progress is reported. (WHK)

20301 (DSE—3412-T3) **Photovoltaic mechanisms in polycrystalline thin-film solar cells. Quarterly technical progress report No. 3, April 27-July 27, 1979.** Zanio, K. (Hughes Research Labs., Malibu, CA (USA)). Oct 1979. Contract ET-78-C-01-3412. 30p. Dep. NTIS, PC A03/MF A01.

Indium phosphide films were prepared on (100) InP substrates by the planar reactive deposition technique in the temperature range 220 to 260°C and growth rates of about 1 μm/hr, complete single-

crystal epitaxy was achieved. The onset of the single-crystal to polycrystalline transition at 245°C is characterized by a mosaic structure. Parallel studies to eventually passivate the grain boundaries in polycrystalline films were undertaken. A 5HCl:3HNO$_3$:4HF etch was found to preferentially attack 90% of the grain boundaries in bulk polycrystalline InP wafers. Canyons with depths greater than 10 μm and widths less than 1 μm were the most common form of attack. Although the etch had no effect on simple twin boundaries, preferential attack was observed at interfaces formed by multiple twinning events.

20302 (DSE—4042-T31) **Commercialization of a thick film solar cell. Quarterly technical progress report, January 1, 1980-March 31, 1980.** McDonald, G.D. (Globe-Union, Inc., Milwaukee, WI (USA)). 1980. Contract EG-77-C-01-4042. 28p. Dep. NTIS, PC A03/MF A01.

Initial problems encountered in the screen printing of CdS films related to an undesirable surface texture on the film surface have been resolved by modification of ink rheology. Improvements have been made in CdS films through modification in firing conditions, ink composition, and fluxing. The CdS 13 micron thick films are devoid of through pores and have a resistivity of 1.65 ohm cm. A laser probe technique was developed to determine macro variations in solar cell films.

20303 (DSE—4042-T32) **Low-cost process for P-N junction-type solar cell.** Mooney, J.B.; Cubicciotti, D.D.; Bates, C.W. Jr. (SRI International, Menlo Park, CA (USA)). Mar 1980. Contract EG-77-C-01-4042. 46p. Dep. NTIS, PC A03/MF A01.

Spray pyrolysis of $CuInS_2$ was studied. The concentrations of copper and sulfur in the spray solutions were increased so as to increase the copper content of the films to the stoichiometric level. Although Auger analysis indicates that this was successful, x ray microanalysis has identified the growth of copper-rich crystals on the surfaces of the deposit. Heat treatment in H_2S did not improve the stoichiometry. The copper-rich crystals were also found on a sample sprayed from a solution with no excess copper. Heterojunctions of glass/SnO_2(Sb)/CdS/CdTe/carbon(Cu)/Ag-In were prepared with a number of methods used to restrict the junction. The various devices failed to exhibit a diode characteristic or a photoresponse. Work on this project is being directed toward understanding the type of junction and how it is formed.

20304 (DSE—4042-T35) **Thin film polycrystalline silicon solar cells. Quarterly report No. 1, October 1-December 31, 1979.** Sarma, K.R.; Rice, M.J.; Legge, R. (Motorola, Inc., Phoenix, AZ (USA). Solar Energy Dept.). 1979. Contract EG-77-C-01-4042. 41p. Dep. NTIS, PC A03/MF A01.

The $MoSi_2$ separation layer growth rate has been studied as a function of time and temperature. The presence of small amounts of O_2 in the silicon deposition ambient were found to inhibit the growth rate of the $MoSi_2$ layer and also to affect the reliability of shear separation. Void formation in silicon at the Si-$MoSi_2$ interface, due predominantly to diffusion of silicon through the $MoSi_2$ layer was observed. This is believed to be responsible for shear separation occurring in the silicon film. Gas chromatograhic procedures were developed for characterizing the silicon deposition process. Coherent twin bundles in the grain-enhanced silicon films were not found to adversely influence solar cell efficiency. Several 1 cm x 2 cm solar cells were fabricated. Performance characteristics of these cells are discussed; the best device had a conversion efficiency of 10.7% (under simulated AM1 illumination) with V/sub OC/ = 0.545 V, J/sub SC/ = 28.65 mA/cm^2 and FF = 68.3%.

20305 (DSE—4106-T2) **Development of recrystallization and thin-film solar cell processes. Quarterly technical progress report No. 2, January 1-March 31, 1978.** Solomon, S.J. (Spire Corp., Bedford, MA (USA)). Apr 1978. Contract EG-77-C-01-4106. 34p. Dep. NTIS, PC A03/MF A01.

Research on fabrication of recrystallized solar cells and energy beam processing of gallium arsenide and homologous compounds is described. The key processes, exclusive of the film recrystallization step, are ion implantation for junction formation followed by pulsed electron beam annealing for activation of the implanted dopants and restoration of lattice perfection and electrostatic bonding of the partially processed film to a glass superstrate combined with simultaneous release from the deposition substrate. (WHK)

20306 (DSE—4106-T3) **Development of recrystallization and thin-film solar cell processes. First quarterly technical status report, October 1-December 31, 1977.** Solomon, S.J. (Spire Corp., Bedford, MA (USA)). Jan 1978. Contract EG-77-C-01-4106. 57p. Dep. NTIS, PC A04/MF A01.

An analytic model for pulse heating effects in silicon films is presented in detail. The objective of the model is prediction of equipment design parameters that are required for recrystallizing silicon films of practical solar cell thicknesses. A brief review of the physics of electron absorption preceeds the presentation of the model. GaAs work during this period has consisted of the mesa diode structure evaluation of thermally annealed shallow implants. V/sub oc/ and I/sub sc/ summaries are presented.

20307 (DSE—4106-T4) **Development of recrystallization and thin-film solar cell processes. Final report, October 1, 1977-September 30, 1978.** Solomon, S.J. (Spire Corp., Bedford, MA (USA)). May 1979. Contract EG-77-C-01-4106. 148p. Dep. NTIS, PC A07/MF A01.

The program had two thrusts: (1) based upon electron-beam thermal treatment of deposited silicon films, to increase crystallite sizes to the range thought to be useful for polycrystalline, thin-film cell fabrication; and (2) to explore the feasibility of applying the directed-energy technologies of ion implantation and pulsed electron beam activation, previously developed for silicon cell fabrication, to junction formation in III-V compounds. The culmination of the recrystallization effort was demonstrating grains broader than the 30-μm film in which they were regrown. This proof of principle was accomplished by means of two-step thermal process that consisted of large-area pulsed electron beam melting followed by small-area heating in a moving DC electron beam. The pulsed beam treatment reduced the three-dimensional disorder of the initial submicrometer crystallite silicon film to one characterized by submicrometercross-section, full-film-thickness, columnar crystallites. The swept beam treatment allowed coalesence of these columnar crystallites, through directional freezing, in the melt path of the beam. It is believed that this demonstration is the first evidence of greater-than-film thickness recrystallization of useful thickness silicon films other than by extended heat treatment at greater than 1350°C. The results of the studies on junction formation in III-V materials, while not so dramatic, have shown that low-energy ion implantation is a potentially viable alternative to liquid or vapor phase epitaxy in the fabrication of GaAs solar cells. Further, the technical feasibility of pulsed electron beam activation of ion implanted junctions in GaAs has been demonstrated. Lastly, the concept of forming front-layer windows of GaP and AlGaAs on GaAs by high-dose ion implantation has been shown to be technically feasible.

20308 (SAN—1712-1) **Development of high efficiency GaAs polycrystal solar cells. Quarterly technical report No. 1, January 23-April 23, 1978.** (Rockwell International Corp., Thousand Oaks, CA (USA). Science Center). 20 Jun 1978. Contract ET-78-C-03-1712. 35p. Dep. NTIS, PC A03/MF A01.

The objective of this program is to develop a thin film polycrystal GaAs solar cell technology with the potential of yielding cells with 12 to 15% efficiency and to develop thin film growth techniques which are compatible with the low cost production goal of $100 to 300/KW peak. During the first quarter, the application of high spatial resolution Auger spectroscopy, SIMS, scanning light microscopy and pulsed laser measurements to measure the chemical and electrical transport properties at grain boundaries in GaAs were studied. These techniques are described and the first measurement of grain boundary resistance is reported. Also, highly oriented polycrystal GaAs was successfully grown on graphite with a columnar grain structure by molecular beam epitaxy (MBE). This growth technique and preliminary characterization on the MBE layers are described.

20309 (SAND—80-7006) **Low-cost photovoltaic cell mount study. Final report.** (Motorola, Inc., Scottsdale, AZ (USA). Government Electronics Div.). Mar 1980. Contract EY-76-C-04-0789. 65p. Dep. NTIS, PC A04/MF A01.

Motorola has performed extensive work on the development of a low-cost photovoltaic concentrator cell mount. A technical and economic evaluation of five representative cell laydown techniques is given with the final goal being a determination of which was most promising from a cost performance basis. The five considered designs are representative of currently employed or proposed laydown techniques: (1) flexible adhesive hold down of the cell; (2) soldering the cell to a metallized alumina wafer; (3) soldering the cell to a plasma-sprayed copper and alumina substrate; (4) soldering the cell to a plasma-sprayed alumina/copper laminated substrate; and (5) soldering the cell to a metallized porcelain wafer. Each of the listed techniques is designed to simultaneously accomplish several engineering requirements necessary for efficient cell mounts. The design should (1) provide 1500 Vdc electrical standoff while maintaining low thermal resistance, (2) accommodate the large difference in thermal expansion coefficients between the silicon cell and the substrate, and (3) provide an efficient means for removing power from cells while minimizing electrical loss. The report contains tabular summaries of the economic and technical performance of each mounting technique. Conclusions are made concerning which design is most cost effective and comments on manufacturing and technical considerations of each mount are presented. Also, tests of an innovative heat dissipation system for passively cooling solar cells employing a reflux cooler panel based on the heat pipe concept are described.

20310 (SERI/TP—351-431, pp 397-401) **Economic analysis of conductor-insulator-semiconductor (CIS) solar cells.** Singh, R. (Colo-

rado State Univ., Fort Collins); Duff, W.S.; DuBow, J.B.; Weaver, N.L.; Rajkanan, K. 1980.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

At the present time a major obstacle to terrestrial applications of photovoltaics is the high cost of solar cells. Possible cost reduction may emerge only from the technological breakthrough in the material and design aspects of solar cells. Both above options are incorporated in conductor-insulator-semiconductor (CIS) solar cells which therefore offer one of the best prospects for cheap solar photovoltaic electricity. The CIS solar cells consist of a base-semiconductor covered by a very thin insulating layer (~ 10 to 30 A) and then a top conducting layer. Recently it has been shown that single crystal silicon CIS solar cells can be fabricated with performance equivalent to p-n junction. in the case of poly and amorphous silicon, the CIS structures have yielded the highest efficiency. Thus the stage has been set for the prototype profeasibility study was based upon the SAMICS methodology developed at the Jet Propulsion Laboratory (JPL). The economic analysis of CIS solar cells is reported based on solar grade silicon $10/kg and amorphous silicon as alternative base-semiconductors.

20311 (SRI—8833-16) **Low-cost process for p-n junction-type solar cell. Quarterly technical progress report 1, September 1-December 1, 1979.** Mooney, J.B. (SRI International, Menlo Park, CA (USA)). Dec 1979. Contract EG-77-C-01-4042. 30p. Dep. NTIS, PC A03/MF A01.

During this first quarter, apparatus was built for the spray pyrolysis of uniform films over areas up to 3 x 4 inches. Procedures were established for the deposition of uniform films of $CuInS_2$. The oxygen content of the films was significantly reduced by substituting nitrogen for air as a propellant and adding a chamber around the spray apparatus to exclude air. Analysis of the films by Auger spectrometry and XPS (ESCA), showed that the Cu/In ratio was not uniform throughout the film. While the bulk was nearly stoichiometric, the surface was deficient in copper. Sintered layers of chlorine-doped CdTe were prepared. The layers were adherent to the substrate and were about 80 percent of theoretical density. Sintered layers were treated with a copper dipping technique and with graphite. Photoresponse was not observed in the copper-treated samples, but a slight photoresponse was observed with graphite.

20312 (SERI/TP—31-248(Vol.2)(Pt.2), pp 1-4) **Low-cost silicon arrays.** Oct 1979.

From Reliability of materials for solar energy workshop; Denver, CO, USA (18 Dec 1978).

20313 (SERI/TP—31-248(Vol.2)(Pt.2), pp 7-50) **Low-cost encapsulation materials for terrestrial photovoltaic modules.** Oct 1979.

From Reliability of materials for solar energy workshop; Denver, CO, USA (18 Dec 1978).

20314 (SERI/TP—31-248(Vol.2)(Pt.2), pp 51-64) **Stability and reliability of CdS/Cu_2S solar cells.** Meakin, J.D.; Phillips, J.E. (Univ. of Delaware, Newark). Oct 1979.

From Reliability of materials for solar energy workshop; Denver, CO, USA (18 Dec 1978).

Topics discussed include CdS/Cu_2S life testing, analysis of degradation mechanisms (oxidation of Cu_2S, diffusion of Cu into CdS, electrolytic decomposition of Cu_2S, and structural instabilities), accelerated life testing, and research needs. (WHK)

20315 (SERI/TP—31-248(Vol.2)(Pt.2), pp 65-68) **Goals and needs.** Oct 1979.

From Reliability of materials for solar energy workshop; Denver, CO, USA (18 Dec 1978).

20316 (SERI/TP—31-248(Vol.2)(Pt.2), pp 69-100) **Transport in thermally grown silica on silicon.** Oct 1979.

From Reliability of materials for solar energy workshop; Denver, CO, USA (18 Dec 1978).

BIOMASS PRODUCTION AND CONVERSION

REFER ALSO TO CITATION(S) 20241, 20243, 20244, 20354, 20837, 21233

20317 (CONF-790749—, pp 128-162) **Survey status of biomass waste and residue fuels for use in directly fired heat engines.** Birkeland, J.W. (Dept. of Energy, Washington, DC); Bendersky, C. Dec 1979.

From Conference on advanced materials for alternate fuel capable directly fired heat engines; Castine, ME, USA (30 Jul 1979).

The DOE Wood Commercialization Program is presently specific to the wood resource but will naturally evolve to include the agricultural resource. This paper is a survey of the status of biomass waste and residue fuels for use in directly fired heat engines and concentrates on the crop and agricultural resource sector. The paper describes the resource sector and the utilization sector and concludes that there is a significant potential for penetration of heat engines into this energy conversion market place. Utilization of biomass can and will provide an important energy supply in the near term. Many conversion options (gasohol, chemicals, direct combustion, etc.) will compete for each type of resource and each will find a proper role. Combustion systems consisting of three approaches are viable: (1) direct fired boilers; (2) LBG gasifiers close coupled to power conversion systems or in retrofit oil/gas direct fired boilers; and (3) pyrolysis followed by direct combustion. The DOE is presently developing plans which will advance the technology state-of-the-art and the rate of market penetration of such systems.

20318 (CONF-7904129—1) **Potential use of organosolv underflow tar LIGNIN as a petrochemical refinery feed.** Griffith, W.L.; Compere, A.L.; Rao, T.K.; Griest, W.H. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 5p. Dep. NTIS, PC A02/MF A01.

From TAPPI microbiology conference; Atlanta, CA, USA (14 Apr 1979).

It appears that underflow tar from an acetone-ethanol-ammonia organosolv pulping run is potentially useful as a low percentage additive to petroleum refinery feed. Although this material has a slightly lower heating value and higher viscosity than do many crude oils, it is a relatively low distilling mixture, based on compound volatility in gas chromatographic tests. Although the high lignin tar has some mutagenic activity, as measured with the Salmonella histidine reversion, or Ames, test procedure, the activity is around two orders of magnitude less than that of coal derived fuel oil. This indicates a potentially lower level of hazard for organosolv tar than for refined coal fuel oil. These findings indicate that those organizations considering the use of an organosolv pulping process should reevaluate final use of the tar in the light of rising petroleum feedstock costs.

20319 (DOE/ET/20006—4) **Increasing the biomass production of short rotation coppice forestry. Quarterly progress report, January 1-March 31, 1980.** Steinbeck, K. (Georgia Univ., Athens (USA). School of Forest Resources). 4 Apr 1980. Contract AS09-77ET20006. 6p. Dep. NTIS, PC A02/MF A01.

The objective of this project is to determine means of increasing the biomass yield of short rotation hardwood forests through certain species admixtures, irrigation, fertilization and intensive cultural practices and the development of techniques for cloning in sterile culture of superior sycamore and other hardwood strains and the identification and propagation of individual hardwoods with superior growth and other characteristics.

20320 (HNEI—79-03) **HSPA molasses and alcohol stillage characterization project. Final report.** Sloane, G.E. (Hawaii Univ., Manoa (USA). Hawaii Natural Energy Inst.). 6 Apr 1979. 35p. Hawaii Natural Energy Institute, Manoa, HI.

Samples of final molasses were collected at the Puunene factory of Hawaiian Commercial and Sugar Company from October 1977 to December 1978 for analysis, conversion into alcohol and stillage, and analysis of the resulting stillage. Sugars, ash, and organic nonsugars were determined on both the soluble and insoluble fractions of the molasses and stillage. The soluble portion of the stillage contained a significant quantity of potassium (average of about 120 lb/ton of molasses) and is of potential value as a fertilizer. The insoluble portion would be a moderately good feed supplement for cattle, swine, and poultry. Centrifuging may be sufficient to separate the fertilizer and animal feed values, although further study will be required to ascertain this. Means of concentrating the fertilizer to practical levels will also require study.

20321 (HNEI—79-04) **Alcohol production from molasses: selection of efficient yeast strains. Final report.** Roberts, R.R. (Hawaii Univ., Manoa (USA). Hawaii Natural Energy Inst.). Jul 1979. 37p. Hawaii Natural Energy Institute, Manoa, HI.

Sixteen yeast strains were procured from commercial and private culture collections to evaluate their relative ability to efficiently ferment blackstrap molasses from the Puunene factory of the Hawaiian Commercial and Sugar Company. In addition, the effects on ethanol production and yeast multiplication of heat treatment of molasses and the addition of nitrogen or phosphorus to the molasses were tested. Three derivatives of yeast strain ATCC 4132 were capable of producing at least 93% of the theoretical yield of ethanol from the sugar in Hawaiian molasses. Yeast strains tested were considered to be highly tolerant to ethanol and all were capable of efficient glucose utilization at a pH of 3.5. Growth rates and yield constants were normal for the species of yeast being tested. Ethanol production of the yeasts tested was maximum when the glucose concentration was 18%. Heat treatment of the molasses had no effect on yield of ethanol or growth of yeast. The addition of nitrogen or phosphorus to the molasses medium had no effect on ethanol production or yeast multiplication.

20322 (NE—1979-8) **IEA/Forestry energy annual report 1979.** (National Swedish Board for Energy Source Development (NE),

Stockholm). Jan 1980. 26p. Dep. NTIS (US Sales Only), PC A03/MF A01.

An account of the activities 1979 and the near term projects is given. Forest energy is defined as the use of short-rotation forestry biomass and forestry residues to produce fuels, petrochemical substitutes and other products. The cooperation is organized in four tasks: systems analysis, growth and production, harvesting, and conversion.

20323 (RLO—2227-T22-27) **Operator's Guide for spreader-stoker combustion systems using agri-wastes (wood residue fuels).** Junge, D.C. (Oregon State Univ., Corvallis (USA)). Sep 1979. Contract EY-76-S-06-2227-022. 34p. Dep. NTIS, PC A03/MF A01.

An experimental research program was conducted at Oregon State University to develop a data base on the combustion characteristics of wood residue fuels as they are burned in industrial spreader-stoker boilers. The results of that experimental program impact on the operation of industrial spreader-stoker boilers and can be used to optimize the performance of these boilers. This is an abbreviated summary of the operational requirements for industrial wood and bark fired spreader-stoker boilers. The primary emphasis is on the role of the operator as a team member and the things he can do as a team member to improve the operation of wood fired boilers. Performance improvement is stressed in terms of completing the combustion reaction in the boiler to improve efficiency and reduce air pollution.

20324 (SERI/TP—351-431, pp 403-412) **Feasibility study for anaerobic digestion of agricultural crop residues.** Ashare, E.; Buivid, M.G.; Wilson, E.H. (Dynatech R/D Co., Cambridge, MA). 1980.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

The objective of this study was to provide cost estimates for the pretreatment/digestion of crop residues to fuel gas. A review of agricultural statistics indicated that the crop residues wheat straw, corn stover, and rice straw are available in sufficient quantity to provide meaningful supplies of gas. Engineering economic analyses were performed for digestion of wheat straw, corn stover, and rice straw for small farm-, cooperative-, and industrial scales. The small farm scale processed the residue from an average size US farm (400), and the other sizes were two and three orders of magnitude greater, respectively. The results of the analyses indicate that the production of fuel gas from these residues is, at best, marginally economical unless a credit can be obtained for digester effluent. The use of pretreatment can double the fuel gas output but will not be justifiable economically unless low chemical requirements or low cost chemicals can be utilized. Additional development is necessary in this area. Use of low cost hole-in-the-ground batch digestion results in improved economics for the small farm size digestion system, but not for the larger systems size.

20325 (SERI/TP—31-248(Vol.2)(Pt.2), pp 483-492) **Construction materials for biomass-energy systems.** Bailey, E.C. (Dolio and Metz Ltd., Chicago, IL). Oct 1979.

From Reliability of materials for solar energy workshop; Denver, CO, USA (18 Dec 1978).

The various methods of conversion of biomass are discussed and it is concluded that no new materials of construction are required. (MHR)

20326 (SERI/TP—31-248(Vol.2)(Pt.2), pp 507-518) **Operation of the biomass liquefaction facility, Albany, Oregon.** Thigpen, P.L. (Rust Engineering Co., Birmingham, AL). Oct 1979.

From Reliability of materials for solar energy workshop; Denver, CO, USA (18 Dec 1978).

The history of the biomass liquefaction process, the basic equations involved, and the steps in the primary operating mode are reviewed. Process and equipment details are presented and problems and difficulties are listed. (MHR)

20327 (SERI/TP—31-248(Vol.2)(Pt.2), pp 538-542) **Materials of construction for gasification.** MacNab, A.J. Oct 1979.

From Reliability of materials for solar energy workshop; Denver, CO, USA (18 Dec 1978).

The following categories of materials problems are discussed and illustrated: high-temperature corrosion, erosion, mechanical properties, and aqueous corrosion. (MHR)

PHOTOCHEMICAL AND THERMOCHEMICAL CONVERSION

20328 (AD-A—072861) **Photoelectrochemical conversion of optical energy to electricity and fuels. Interim technical report.** Wrighton, M.S. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Chemistry). 8 Aug 1979. Contract N00014-78-C-0630. 37p. NTIS, PC A03/MF A01.

Though the first documented photovoltaic effect is associated with a semiconductor/liquid junction, it has not been until very recently that significant solar energy conversion efficiency could be realized with a photoelectrochemical device. A semiconductor/liquid junction solar cell is one where one or both electrodes in an electrochemical cell is semiconductor such that irradiation of the semiconductor(s) results in the non-spontaneous flow of electric current in the external circuit. Photogeneration of storable chemical fuels in the form of electrolytic products is possible, in addition to the prospect of converting light only to electricity when the redox reaction occuring at one electrode is the reverse of that at the other. The aim of this report is to outline our recent research accomplishments in the field of photoelectrochemistry. Our work in this area began in late 1974 - more than a century after the first studies of photoeffects upon irradiation of an electrode in a cell and a number of years after modern pioneering studies of semiconductor/liquid interfaces which led to the formulation of our present working hypotheses of such interfaces exposed to optical illumination.

20329 (COO—4380-3) **Organic photochemical storage of solar energy. Progress report, February 1, 1979-January 31, 1980.** Jones, G. II. (Boston Univ., MA (USA). Dept. of Chemistry). Feb 1980. Contract EG-77-S-02-4380. 17p. Dep. NTIS, PC A02/MF A01.

Study of valence isomerization of organic compounds has focused on two mechanisms of photosensitization involving either electron donor-acceptor interaction or energy transfer. The quenching of fluorescent sensitizers by isomerizable substrates results in the formation of excited complexes. These sensitizer-substrate pairs are highly polarized, leading to changes in bond order for the substrates. For several substrates such as quadricyclene, hexamethyldewarbenzene, and a nonbornadiene derivative, this perturbation results in efficient valence isomerization. Isomerization observed on irradiation of charge transfer complexes of isomerizable substrates is consistent with a similar exciplex - template mechanism. The energy transfer mechanism of photosensitization has been studied by measuring the temperature dependence of quantum yield for isomerization of dimethyl norbornadiene-2,3-dicarboxylate sensitized by benzanthrone. From temperature and quencher concentration profiles quenching constants have been obtained which are consistent with an endoergic triplet energy transfer mechanism. The thermal upconversion of the low energy triplet of benzanthrone results in a threefold increase in isomerization quantum yield over a 90° temperature range.

20330 (DSE—4042-T8) **Electrochemical photovoltaic cells. Project 65021 quarterly technical progress report, July 15-October 15, 1979.** Ang, P.G.P.; Sammells, A.F. (Institute of Gas Technology, Chicago, IL (USA)). Oct 1979. Contract EG-77-C-01-4042. 35p. Dep. NTIS, PC A03/MF A01.

During the second quarter of this program we have evaluated the photoelectrochemical performance of single-crystal $MoSe_2$ and GaAs, polycrystalline CdSe, and cells with $RbAg_4I_5$ solid electrolyte. $MoSe_2$ electrode exhibited very good photoresponse in electrolytes containing Br^-/Br_2 redox couple. The photopotential and photocurrent were larger in acid than in alkaline electrolyte. A power conversion efficiency of about 5% was achieved under 200 mW/cm^2 Xenon light illumination in the acid medium. The catalytic activity of a platinized platinum electrode toward Br^-/Br_2 redox couple was also better in acid electrolyte than in alkaline electrolyte. Higher current densities were obtained in the acid medium. The $MoSe_2$ was found to have good stability in acid and alkaline electrolytes; however, it will be necessary to protect the electrolyte against evaporation of the bromine, oxidation by air, or photodecomposition. GaAs was tested in alkaline electrolytes containing Se^{2-}/Se/sub n/$^{2-}$, I^-/I_2 or Br^-/Br_2 redox couple and in acid electrolytes containing Fe^{+3}/Fe^{+3}, Cr^{+2}/Cr^{+3}, Sn^{+2}/Sn^{+4}, Cu^{+1}/Cu^{+2}, Ti^{+3}/Ti^{+4}, I^-/I_2 or Br^-/Br_2. Large anodic dark currents were observed in solutions containing Sn^{+2}/Sn^{+4} or Cu^{+1}/Cu^{+2}. The large photoeffects found with the other redox couples were usually accompanied by electrode darkening and decrease in photocurrent with time. Polycrystalline electrodes have been made by thermal vacuum evaporation of CdSe on titanium foil or SnO_2-coated glass. The CdSe still suffered from poor adherence to the substrates and, therefore, poor photoresponse. A solid electrolyte photoelectrochemical cell was fabricated giving photopotentials of about 300 mV at current densities of about 0.1 mA/cm^2 under 200 mW/cm^2 Xenon light illumination.

20331 (SERI/TP—31-248(Vol.2)(Pt.2), pp 363-370) **Westinghouse sulfur cycle hydrogen production process.** Oct 1979.

From Reliability of materials for solar energy workshop; Denver, CO, USA (18 Dec 1978).

20332 (SERI/TP—31-248(Vol.2)(Pt.2), pp 371-421) **Materials consideration for the Westinghouse Sulfur Cycle Hydrogen Production Process.** Ammon, R.L.; Parker, G.H.; Farbman, G.H. (Westinghouse Electric Corp., Pittsburgh, PA). Oct 1979.

From Reliability of materials for solar energy workshop; Denver, CO, USA (18 Dec 1978).

The Sulfur Cycle Hydrogen Production Process is a hybrid electrochemical/thermochemical process for decomposing water into hydrogen and oxygen. The thermochemical portion of the

process requires the vaporization of concentrated sulfuric acid and subsequent thermal decomposition of the resulting sulfur trioxide. In order to maximize efficiency, the process is carried out at elevated pressures. The acid vaporizer which operates at temperatures of approximately 846°F and the reduction reactor which operates at approximately 1600°F place unique requirements on structural materials. A program to investigate the compatibility of potential candidate structural materials for use in the vaporizer and reduction reactor has been initiated.

PHOTOVOLTAIC POWER PLANTS

REFER ALSO TO CITATION(S) 20268, 20341, 20353, 20521

20333 (ALO—4281-1) **Sun Valley Photovoltaic Power Project, Phase 1. Final report, June 1, 1978-February 28, 1979.** Goodman, F.R. Jr. (Los Angeles City Dept. of Water and Power, CA (USA)). Mar 1980. Contract ET-78-C-04-4281. 166p. Dep. NTIS, PC A08/MF A01.

An application experiment was devised for fabrication, installation, operation, and evaluation of a concentrating photovoltaic system for direct conversion of sunlight to electricity. If the experiment is performed, the photovoltaic system will be connected to an electric motor load and to an electric utility system. Provisions will be made to allow the motor load to be supplied with power from either the photovoltaic system or the utility system. When the demand of the motor load is low, the photovoltaic system will deliver excess power to the utility system for use elsewhere. Thus, the experimental installation has been designed with sufficient flexibility to enable several modes of operation to be evaluated. This type of application is a typical example of on-site power generation at an individual load center involving two-way energy exchange with the adjacent utility system. Because a growing market for photovoltaic systems in this type of application is expected in the 1980's, the experiment will provide needed information in a timely manner. The experiment was devised jointly by the Los Angeles Department of Water and Power (LADWP) and its subcontractor, Spectrolab, Inc. LADWP will furnish a site and operate the equipment after installation. The subcontractor will manufacture and furnish a concentrating photovoltaic array with a power rating of approximately 200 kilowatts at one kilowatt per square meter of insolation. Other required equipment will be purchased to specification from appropriate suppliers. The photovoltaic system represents a state-of-the-art design at the time this report was prepared. However, minor design improvements may be made prior to and during system installation. All phases of fabrication, installation and operation will be documented through formal reports. The results of the experiment will contribute to the goals of the National Photovoltaic Conversion Program.

20334 (SAND—79-2186) **Photovoltaic test system.** Verardo, A.E. (Sandia Labs., Albuquerque, NM (USA)). Feb 1980. Contract EY-76-C-04-0789. 86p. Dep. NTIS, PC A05/MF A01.

A computer-controlled test system which is in operation at the Photovoltaics Advanced Systems Test Facility located at Sandia Laboratories is described. The test system is used to characterize the electrical and thermal performance of various types of photovoltaic hardware currently being evaluated at Sandia Laboratories. A detailed hardware description, a software description of typical test programs, and system operation procedures are included.

20335 (SERI/TP—351-431, pp 105-111) **Flat-plate photovoltaic array simulation and design analysis.** Weaver, R.W. (Jet Propulsion Lab., Pasadena, CA). 1980.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

As part of the Jet Propulsion Laboratory's Low-cost Solar Array Project, a comprehensive program of flat-plate solar array design and cost optimization has been carried out. The objectives of these studies have been to improve reliability and reduce costs of arrays. Two simulation methodologies were developed. The first allows the analyst to determine the probable power loss due to cell or module failure for various array circuit designs. This method has been computerized and used to analyze various circuit designs with differing levels of series/paralleling. The second method was developed to determine the life-cycle cost of energy produced by a specific system design. This simulation also indicates which failure replacement strategy should be used to insure minimum life-cycle cost.

20336 (SERI/TP—351-431, pp 113-117) **Method for predicting long-term average performance of photovoltaic systems.** Gupta, Y.; Young, S. (Science Applications, Inc., McLean, VA). 1980.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

Based on the utilizability concepts of Liu and Jordan, an analytic model has been developed to predict the long-term average performance of grid-connected photovoltaic power systems. In contrast with hourly simulation, the methodology utilizes insolation probability distributions and correlations to evaluate long-term PV system performance, including energy flows from array directly to load, through storage to load, and to the utility for sellback systems. The method has been validated by comparison with hourly simulation results and can be adapted for rapid computer simulation or for hand-held programmable calculators.

20337 (SERI/TP—351-431, pp 419-424) **Solar technology for central station applications: a regional market analysis approach.** Silverman, B.G. (George Washington Univ., Washington, DC); Fontaine, P.; Hietanen, P.L. 1980.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

An approach to market penetration analysis is described using solar thermal, photovoltaics, ocean thermal energy conversion, hydrothermal and several more traditional electricity generation concepts in four NERC regions as an example. The technologies are characterized and the steps in the market penetration approach are described. Gas-fired, hydrothermal, synthetic fuel and coal-fired power plants exhibit the greatest market capture by 2010. Solar thermal also performs well.

SOLAR THERMAL POWER PLANTS

REFER ALSO TO CITATION(S) 20268, 20337, 20463, 20521

20338 (PNL-SA—7580) **SOLSTEP: a computer model for predicting the thermodynamic and economic performance of solar thermal power plants.** Bird, S.P. (Battelle Pacific Northwest Labs., Richland, WA (USA)). May 1979. Contract EY-76-C-06-1830. 28p. (CONF-791205—20). Dep. NTIS, PC A03/MF A01.

From ASME winter annual meeting; New York, NY, USA (2 Dec 1979).

A thermodynamic and economic performance analysis code, SOLSTEP, was developed to facilitate the evaluation of solar thermal power plant designs. The code conducts a time step simulation of the plant thermodynamic performance using actual recorded meteorological and insolation data. Each analysis case provides capacity factor and levelized energy cost results for several plant configurations using various combinations of collector field size and storage capacity. The code has been used to analyze a variety of solar thermal generic concepts involving several collector types and energy conversion and storage subsystems.

20339 (SAN—1726-1(Vol.1)) **Closed Brayton cycle advanced central receiver solar-electric power system. Volume 1: executive summary. Final report.** Schroeder, J.B. (Boeing Engineering and Construction Co., Seattle, WA (USA)). Nov 1978. Contract EG-77-C-03-1726. 40p. Dep. NTIS, PC A03/MF A01.

A summary of a one-year study of an advanced central receiver solar-electric power system is presented. The selected system is described, and its technical and cost performance summarized. The technology requirements and limitations to the system's development are defined. The development plan for the commercialization of the system is summarized in terms of schedules, activities and funding requirements.

20340 (SERI/TP—351-431, pp 137-140) **Comparison of solar thermal power systems.** Iannucci, J.J.; Eicker, P.J. (Sandia Labs., Livermore, CA). 1980.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

Because of past development efforts, three major candidates currently exist for solar thermal power systems: central receivers, parabolic troughs, and parabolic dishes. In this study, systems using each of these technologies have been designed and costed to provide thermal energy at 93, 149 and 316°C (200, 300 and 600°F) for end use sizes of 3, 30, 300, and 1500 MWth. Higher temperature designs were also generated for the central receiver systems. Each system was engineered to the same specifications and applications as constraints. As examples, all systems can survive the same wind speeds and are made of the same materials where appropriate at the same unit costs. The results point up the principal design differences and allow one to rank these three technologies, based on annual delivered thermal energy costs, for a range of applications and end use sizes.

20341 (SERI/TP—351-431, pp 221-228) **Performance of distributed active solar power systems.** Curto, P.A.; Bjustrom, R.C.; Coluzzi, M.E.; Manley, R.N.; Cherdak, A.S.; Eldridge, F.R.; Jacobsen, W.E. 1980.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

The performance of an active solar power system depends upon the available solar resource, equipment characteristics and load

profile. A distributed solar power systems performance simulation model is developed that can handle all classes of windpower, solar thermal process heat and electricity, and photovoltaics systems. This model utilizes hourly insolation, windspeed, temperature and pressure data (derived from SOLMET tapes, available from the National Climatic Center), characterizations of over 200 classes of solar equipment components and subsystems, and hourly electrical and thermal load data for selected industrial, commercial, institutional, agricultural and residential applications (including seasonal variations). Model outputs include peak array power, annual collected energy, solar fraction, backup energy requirements, peak backup load power, excess generated energy available for sale or waste, average hourly generation profiles, and other related data. System performance can be determined for up to 72 different applications and 26 locations for various array sizes and storage capacities.

20342 (SERI/TP—31-248(Vol.2)(Pt.2), pp 633-639) **High temperature corrosion fatigue.** Indig, M.E. (General Electric Co., Pleasanton, CA). Oct 1979.

From Reliability of materials for solar energy workshop; Denver, CO, USA (18 Dec 1978).

20343 **Line focus power plants: another utility alternative.** Fong, A.; Rhodes, G.W.; Semmens, M.G. (BDM Corp., Albuquerque, NM). *Sol. Eng. Mag.;* **4**: No. 9, 18-20(Sep 1979).

Some design and economic considerations based on a conceptual study of a 100 megawatt electrical solar central power plant utilizing a linear parabolic trough collector are discussed. Seven line focus power plant subsystems are considered in detail, including the collector system, the receiver tubes, thermal working fluids, heat transport system, energy storage, electrical power generating system, and the master control subsystem. Enhanced performance and reduced cost of the linear parabolic trough are cited as the most important steps in developing an economically attractive line focus power plant technology. (SPH)

20344 **DOE strategy framework for high temp markets.** Braun, G.W. (Dept. of Energy, Washington, DC). *Sol. Eng. Mag.;* **4**: No. 9, 25-29(Sep 1979).

The DOE Solar Technology Program, whose aim is to develop a self-sustaining solar-thermal industry, is discussed. The evolution of the program through the decade of the 1970's is reviewed. The current program for solar thermal development emphasizes the commercialization of products by the early 1980's. Industrial process heat is viewed as a major near term market requiring solar fossil hybrid systems. The economic prospects for the central power tower concept and retrofit repowering concepts are considered. Receiver engineering development on trough, fixed-bowl, and parabolic dish collectors is discussed. In addition to advanced receiver design development, the program budget includes funding for research and development of optical and thermal materials, thermal energy storage, environmental studies, insolation data collection and model development, and technology information dissemination. (SPH)

CENTRAL RECEIVER

REFER ALSO TO CITATION(S) 20242, 20459

20345 (SERI/TP—351-431, pp 209-214) **Simulation and design methods for a solar central receiver hybrid power system.** Walzel, M.D. (Univ. of Houston, TX). 1980.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

The simulation and design of the solar collector portion of advanced sodium cooled central receiver power systems has been carried out at the University of Houston. The application is in the area of electric power generation utilizing solar thermal technology and using coal as an alternate energy source when the solar component is down. The analysis of the solar part of the system, which was analyzed separately from the coal fired system, will be presented. Simulation methods include modeling of the sun, the action of the heliostats, and calculating the resulting flux profile on the receiver. The component cost and loss functions are involved in the design phase. This includes finding the optimum distribution of heliostats and the boundary of the collector field for a specific tower height and receiver size. This information and a figure of merit are output for several tower heights and receiver sizes. The optimum power plant size and configuration for a design point can then be selected.

20346 **Central receiver solar collector using analog coupling mirror control.** Sommer, W.T. US Patent 4,172,443. 30 Oct 1979. Filed date 31 May 1978. 58p.

A solar collector is disclosed having a central radiation receiver and a plurality of mirrors mounted on articulated mounting structures arranged over a surface in an array pattern comprised of discrete paths, with the path shapes having certain prescribed symmetry properties. Using mathematical properties of tilt angle components expressed relative to fixed orthogonal axes of resolution for mirrors oriented to reflect solar radiation onto the radiation receiver, mirror control is accomplished by the use of coupling devices which extend along the discrete mirror containing paths. Each coupling device comprises a passive linear series system having an appropriate gradient of component values. The types of linear series coupling devices specifically considered in the disclosure are tensile elastic coupling devices and electrically resistive coupling devices for mirror control in large scale collectors, and torsional elastic coupling devices for mirror control in small scale collectors. Direct use of the coupled control information requires the use of unconventional mirror mounts which structurally incorporate the fixed orthogonal axes of resolution as mirror mount axes. The mirrors for large scale collectors are mounted on individual mirror mount structures, and appropriate mirror array patterns may be established on any reasonably smooth terrain. The torsional coupling devices intended for use in small scale collectors are used as structural members in a collective mounting structure for the mirrors as well as serving to couple tilt angle information along the individual coupling devices.

20347 (SERI/TP—31-248(Vol.2)(Pt.2), pp 137-155) **Solar central receiver heliostat designs.** Mavis, C.L. (Sandia Labs., Livermore, CA). Oct 1979.

From Reliability of materials for solar energy workshop; Denver, CO, USA (18 Dec 1978).

Two generations of heliostats have been developed for the solar central receiver collector subsystem. Heliostats using glass mirrors and heliostats using light weight plastic film mirrors which are protected by a plastic enclosure have been developed. The design features and materials used in the two basic types of heliostats are summarized. The estimated annual cost for a field of heliostats is also included.

20348 **Testing for commercialization of the central power tower.** Duquette, F. (McDonnell Douglas Astronautics Co., Huntington Beach, CA). *Sol. Eng. Mag.;* **4**: No. 9, 15, 17(Sep 1979).

Progress is reported in the construction of the 10 megawatt electrical pilot plant project near Barstow, CA, for testing the feasibility for commercialization of a central power tower system. The development and design of the central receiver concept is reviewed. The economic competitiveness of central tower systems with conventional electrical generation system is discussed, and factors affecting the early commercialization of central power systems are considered. (SPH)

DISTRIBUTED COLLECTOR

20349 (PNL-SA—7567) **SHADE: a computer model for evaluating the optical performance of two-axis tracking parabolic concentrators.** Apley, W.J. (Battelle Pacific Northwest Labs., Richland, WA (USA)). May 1979. Contract EY-76-C-06-1830. 9p. (CONF-791205—21). Dep. NTIS, PC A02/MF A01.

From ASME winter annual meeting; New York, NY, USA (2 Dec 1979).

A computer model SHADE (Selection of Heliostat Arrangement for Distributed Engines) has been developed at the Pacific Northwest Laboratory to aid in determining the optical performance of two-axis tracking parabolic concentrators. The shading of individual mirror assemblies in a field of parabolic dishes determines the optimal field arrangement and the most efficient method of plant operation. SHADE provides a simple and inexpensive analytical tool for examining certain design aspects of solar thermal power systems using a network of point-focusing parabolic concentrators.

20350 (SERI/TP—351-431, pp 181-186) **Analysis of the economic viability of a solar thermal point focusing electric plant for Santa Catalina Island - a case study.** Kasper, J.V.V. (Univ. of California, Los Angeles); Davis, R.B. 1980.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

The effective cost of electricity generation to the Catalina Island utility system was determined for a combined diesel/solar thermal electric plant. This cost was compared to the effective cost of electricity generation for an all-diesel electric plant, the status quo on Catalina. Breakeven solar system capital costs were calculated for various future scenarios. The Alternative Power System Economic Analysis Model (APSEAM), a cash flow computer model, was used to perform the computations. Conclusions from the analysis include: (1) for the base case assumptions, the Catalina Island utility would be financially indifferent between diesel power generation and diesel/solar thermal power generation at a solar capital cost of $2475/kWe; (2) the solar system breakeven capital cost is strongly dependent on the method of financing of the capital investment, varying from $1535/kWe for 100% equity financing (at a rate of 17%) to $6240/kWe for 100% bond financing (at a rate of 12%); (3) the solar system breakeven capital cost for Catalina Island is quite sensitive to the specifics of the escalation rate of fuel costs over time. A constant annual fuel escalation rate of 11% over the 1980 to 2015 time frame has about the same impact on the solar system breakeven capital cost as a 30% escalation rate for the first three years of that time period and an 8% escalation rate thereafter.

TOTAL ENERGY AND HYBRID SYSTEMS

REFER ALSO TO CITATION(S) 20344

20351 (ATR—80(7743)-1) **Fort Hood solar total energy project: technical support and systems integration. Third semiannual report, May 1, 1979-October 31, 1979.** (Aerospace Corp., El Segundo, CA (USA). Energy and Resources Div.). 1 Feb 1980. Contract AC04-78AL04271. 32p. Dep. NTIS, PC A03/MF A01.

Work on the Fort Hood STES which was planned by DOE as a Large Scale Experiment for the Solar Total Energy Program is described. The history of the design evolution and management of the project which began in 1973 is summarized. The project was discontinued by DOE in December 1979. Supporting studies underway at the time are reported including: (1) reassessment of energy loads, (2) revised system concept, (3) plant sizing calculations, and (4) insolation variation measurement planning. (WHK)

20352 (CONF-791205—22) **Economic comparisons of solar and fossil total energy systems for industrial applications.** Pine, G.D. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 10p. Dep. NTIS, PC A02/MF A01.

From ASME winter annual meeting; New York, NY, USA (2 Dec 1979).

Four industrial application case studies were completed comparing fuel cell, diesel, and solar central receiver total energy systems with boiler and grid-electric systems. All total energy systems save significant quantities of fuel compared with separate supply of electricity and heat. However, the fuel cell and diesel systems require natural gas and oil, respectively, and while using less total fuel, they may substitute the use of these fuels for more plentiful coal or uranium. Solar total energy systems, on the other hand, reduce not only total fuel consumption, but also the oil and gas consumption. Solar systems are relatively capital intensive, but show significant economies of scale. They were found to compete well with the other systems in sizes larger than two to three MWe, but not so well for smaller sizes.

20353 (SERI/TP—351-431, pp 119-124) **Performance studies of combined photovoltaic/thermal solar heating and cooling systems.** Venkateswaran, S.R.; Anand, D.K. (Univ. of Maryland, College Park). 1980.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

A simulation study of combined photovoltaic/thermal (PV/T) solar collector-series heat pump systems for heating and cooling applications is presented. A computer program incorporating detailed performance models for the PV/T collector, electrical and thermal storage, heat pump and building load is developed to simulate the year-round operation of such a system. System simulations are made for three US locations to study the effect of important design parameters on the collector and overall system electrical and thermal performance. The long term performance is found to be relatively insensititve to electical and thermal storage size over mot of the range of values of practial interest. The collector area, orintation and performance parameters as well as the geographical location dependent weather and building loads have a significant effect on the system performance that is critical from the point of view of design. Combined PV/T collector-heat pump systems are found to have the maximum potential for energy savings in cold regions with high thermal loads.

20354 (SERI/TR—35-078(Vol.3)) **Conversion system overview assessment. Volume III. Solar thermal/coal or biomass derived fuels.** Copeland, R.J. (Solar Energy Research Inst., Golden, CO (USA)). Feb 1980. Contract EG-77-C-01-4042. 33p. Dep. NTIS, PC A03/MF A01.

The three volumes of this report cover three distinct areas of solar energy research: solar thermoelectrics, solar-wind hybrid systems, and synthetic fuels derived with solar thermal energy. Volume III deals with the conversion of synthetic fuels with solar thermal heat. The method is a hybrid combination of solar energy with either coal or biomass. A preliminary assessment of this technology is made by calculating the cost of fuel produced as a function of the cost of coal and biomass. It is shown that within the projected ranges of coal, biomass, and solar thermal costs, there are conditions when solar synthetic fuels with solar thermal heat will become cost-competitive.

OCEAN THERMAL GRADIENT POWER PLANTS

REFER ALSO TO CITATION(S) 20337, 20532, 21192

20355 (ANL/OTEC-BCM—007) **Inspection of aluminum components from freeze desalting facility at Wrightsville Beach, NC.** Melton, D.G.; Lee, T.S. (International Nickel Co., Inc., Wrightsville Beach, NC (USA)). Feb 1980. Contract W-31-109-ENG-38. 27p. Dep. NTIS, PC A03/MF A01.

An inspection was made of a freeze-type desalting pilot plant that has operated for approximately four years. The purpose of this inspection was to document the seawater service experience of the various aluminum alloys present in the plant. The components inspected include two tube-type heat exchangers, one plate-type heat exchanger, and the freezing compartment. Photographs are used to illustrate the corrosion behavior of these components.

20356 (CONF-790631—13) **Foam OTEC System.** Zener, C.; Greenstein, M. (Carnegie-Mellon Univ., Pittsburgh, PA (USA)). Jul 1979. Contract EG-77-S-02-4459. 21p. Dep. NTIS, PC A02/MF A01.

From 6. OTEC conference; Washington, DC, USA (19 Jun 1979).

Experiments are described which attempt to incorporate the main features of a Foam OTEC System. These features include foam generation, foam rise, foam breaking, and finally separation of liquid and vapor. Our foam generator formed foam at rates as high as would be desired in a commercial plant, ~ 1 gram/cm^2 sec. The rise of the foam, accompanied by a drop in temperature, was as expected by theory. The foam breaking, and the subsequent separation of liquid and vapor, presented no problem. Totally unexpected was the dominant role played by the wall drag in our 4" diameter, 30' high column. Experiments were consistent, however, with a very simple expression for the variation of the drag coefficient with the foam parameters of mass flow rate and density. For the large diameter columns envisioned for commercial plants, wall drag will play only a minor role. Likewise unexpected was the large surfactant concentration (~ 1000 ppM) required to maintain complete foam stability to the top of the column. The periodic appearance of large bubbles at lower concentrations may be generated by our high rates of shear strain, greater than 20/sec. Another problem which must be solved is common to all open cycle systems. This is deaeration.

20357 (CONF-790631—14) **Thermally induced flow of high expansion aqueous foam in a vertical pipe.** Greenstein, M.; Zener, C. (Carnegie-Mellon Univ., Pittsburgh, PA (USA)). 1979. Contract EG-77-S-02-4459. 39p. Dep. NTIS, PC A03/MF A01.

From 6. OTEC conference; Washington, DC, USA (19 Jun 1979).

Foam was generated by air injection into an aqueous surfactant solution. Cooling from about 25°C to about 15°C, the foam flowed through a 30' high, 4" diameter glass column. At the top of the column, an alcohol drip broke the foam. A cold water direct contact condenser backed by a rotary vacuum pump eliminated the air and water vapor released from the ruptured foam cells. A differential equation involving a single empirical parameter describes the flow. The dependence of this parameter on flow rate indicated that the foam flow had a dissipative loss similar to that of laminar flow of liquids in pipes. This conclusion holds for flow rates up to 0.5 gm/(cm^2-sec).

20358 (CONF-790631—15) **Recent developments in the foam OTEC system.** Zener, C.; Molini, A.; Fort, T. Jr.; Fetkovich, J.; Greenstein, M. (Carnegie-Mellon Univ., Pittsburgh, PA (USA)). 1979. Contract EG-77-S-02-4459. 7p. Dep. NTIS, PC A02/MF A01.

From 6. OTEC conference; Washington, DC, USA (19 Jun 1979).

In the foam open cycle OTEC system warm water literally lifts itself several hundred feet. In preliminary experiments the foam behavior seemed to depend in a capricious manner upon the temperature of the incoming water, the pressure of the spray condenser, and the foam mass flow rate. Through a combination of analysis and experiment we have developed an equation which governs the steady state rise of a foam column. This equation correctly predicts the effects upon the foam behavior of all controllable parameters. These parameters include, in addition to these mentioned above, the diameter and height of the foam column. It is shown that foam generated in an appropriate manner flows laminarly rather than turbulently, and has a well defined drag function. This drag function decreases as the inverse square of the column diameter.

20359 (DOE/ET/21002—T2) **OTEC support services. Quarterly technical progress report No. 7, 15 November 1979-14 February 1980.** (VSE Corp., Alexandria, VA (USA)). Feb 1980. Contract ET-78-C-02-4931. 19p. Dep. NTIS, PC A02/MF A01.

The technical engineering and management support services provided by VSE corporation for the Ocean Thermal Energy Conversion Program of the Ocean Systems Branch, Division of Central Solar Technology during this quarter are described. The seven tasks include (1) survey, analysis evaluation, and recommendation concerning program performance, (2) program technical monitoring, (3) development and implementation of methodology to identify and evaluate program alternatives, (4) technical assessments, (5) OTEC system integration, (6) environment and siting considerations; and (7) transmission subsystem considerations. (WHK)

SOLAR RADIATION UTILIZATION

20360 (EUR—6669) **Energy. Application of solar energy in dwellings: a technical and economical analysis for the European Community.** (Commission of the European Communities, Brussels (Belgium)). 1980. 183p. Dep. NTIS (US Sales Only), PC A09/MF A01.

The technical possibilities and economical limitations of solar heating systems for the application in swimming-pools, hot water preparation, space heating and air conditioning were investigated. This analysis was performed for dwellings with special consideration of the climatic differences in each E.C. country. The computer program, which was used for solar system calculations, and all mathematical models for technical and economical analysis are explained. In the technical and economical analysis the most suitable solar system sizes for each E.C. country was determined. Four types of solar collectors were investigated. The single glass selective collector proved to be the most cost effective collector in all the above applications, provided for that the additional cost for the selective coating is not more than 20 DM/m^2. From the results of the analysis certain recommendations were derived, which can improve the rapid implementation of solar heating systems into the market.

20361 (GRI—78/0004) **Overview of research and development activities in solar thermal energy.** (Booz, Allen and Hamilton, Inc., Bethesda, MD (USA)). Nov 1978. 79p. NTIS PC A05/MF A01.

The purpose of this study is to provide the Gas Research Institute (GRI) with an overview of research and development activities which are currently being conducted by industry and government in those solar technologies of direct relevance to the GRI solar program. Specifically, it examines research activities on solar technologies that can be used to augment natural gas in solar residential and industrial applications, solar-augmented water heating, solar-assisted heat pumps, and research activities in solar heating and cooling evaluation. This overview is intended to provide GRI with an information base for ensuring that its programs are coordinated with activities of industry and government and to assist GRI in planning its research program. This report was developed utilizing data collected from gas companies, equipment manufacturers, profit and nonprofit research organizations, and various federal and state governments. In-depth telephone interviews were conducted with officials of these organizations to provide the basic data on their activities. In addition, numerous reports relating to solar research and development were reviewed. Findings are presented and discussed. (WHK)

SPACE HEATING AND COOLING

REFER ALSO TO CITATION(S) 20419, 20439, 20452, 20460, 20718, 20792

20362 **Cooperative heat transfer and ground coupled storage system.** Metz, P.D. US Patent Application 037,077. [nd]. 11p.

A cooperative heat transfer and ground coupled storage system wherein collected solar heat energy is ground stored and permitted to radiate into the adjacent ground for storage therein over an extended period of time when such heat energy is seasonally maximally available. Thereafter, when said heat energy is seasonally minimally available and has propagated through the adjacent ground a substantial distance, the stored heat energy may be retrieved by a circumferentially arranged heat transfer means having a high rate of heat transfer.

20363 (ALO—4135-T1) **Solar atrium: a hybrid solar heating and cooling system. Technical progress report No. 8, June 19, 1979-September 19, 1979.** Ueland, M. (Ueland and Junker, Architects and Planners, Philadelphia, PA (USA)). 28 Sep 1979. Contract EG-77-G-04-4135. 10p. Dep. NTIS, PC A02/MF A01.

A program of applied research has been developed for the design, construction and monitoring of an innovative concept of solar heating and cooling called solar atrium. The solar atrium concept is adaptable to residences and smaller commercial and institutional buildings. It is designed to be constructed of materials and equipment that are economical and readily available. Cost-effectiveness of installation and operation is a primary design objective. The solar atrium incorporates the large glass areas of the earlier houses and adds facilities for heat storage and control of heat losses through glass.

20364 (CONF-791022—15) **Roof overhang design for solar control.** Barnes, P.R. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 15p. Dep. NTIS, PC A02/MF A01.

From 4. national passive solar energy conference; Kansas City, KS, USA (3 Oct 1979).

Design formulas are developed for both fixed and extendable overhangs as a function of window height, geographic latitude and solar altitude. The extendable overhang is adjusted seasonally. Design parameters are suggested for near optimum solar control in direct-gain passive systems. A method of estimating the effect of an overhang on solar gain is also developed. Examples of the solar performance for both fixed and adjustable overhangs are presented for 36°N latitude.

20365 (COO—2731-2) **Commercial solar demonstration performance evaluation report: Basking Ridge, New Jersey, Environmental Education Center.** (General Electric Co., New York (USA)). Mar 1979. Contract EY-76-C-02-2731. 66p. Dep. NTIS, PC A04/MF A01.

The Somerset County Park Commission for Somerset County, New Jersey, undertook the project of incorporating a solar heating, cooling, and domestic hot water system as part of its newly-constructed Environmental Education Center (EEC) located in Lord Stirling Park, Basking Ridge, New Jersey. It is the objective of this solar energy project to demonstrate the feasibility and effectiveness of using solar energy collected via 3100 sq.ft. of flat plate solar collectors to space heat, cool, and supply domestic hot water to the 18,000 sq.ft. EEC building. The project is also intended to demonstrate the aesthetics and effectiveness of incorporating an integrated solar collector array onto the roof of the newly constructed EEC facility. The results of the solar system performance for the one-year operational period are presented. (MHR)

20366 (COO—4520-1) **Cost-effective ways to improve the fabrication and installation of solar heating and cooling systems for residences. Final report, June 1, 1977-September 30, 1978.** Thayer, S.B.; Jacobs, P.; Weaver, N. (Colorado State Univ., Fort Collins (USA). Solar Energy Applications Lab.). Oct 1978. Contract EG-77-S-02-4520. 134p. Dep. NTIS, PC A07/MF A01.

A Colorado State University Solar Energy Applications Laboratory study investigating cost-effective ways of improving fabrication and installation of residential solar energy heating systems is documented. The study entailed on-site observation of twelve installations focusing on the phase of mounting and manifolding of solar collectors. Time lapse photography and work measurement techniques were employed to record these installations. Generic collector types studied included air and liquid panels both internally and externally manifolded. Principal findings of the study synthesized from field observations, analysis of photographic data, time studies, and discussion with installation personnel and manufacturers' representatives are presented in the technical report.

20367 (DOE/CS—0148A) **Report on extending the solar program in Federal buildings.** (Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy). Feb 1980. 11p. Dep. NTIS, PC A02/MF A01.

The potential benefits of extending the Solar in Federal Buildings Program are presented. Some of these are: meeting National Energy Conservation Policy Act goals, centralized management of program elements, establish central coordination of federal agency solar activities, assert federal government leadership role in promoting solar technologies, guarantee market support to solar industry, expanding federal agency solar activities, development of private and public sector solar capabilities, and enhancement of solar product development effort. (MHR)

20368 (DOE/CS/30242—2) **Passive solar heating of buildings with attached greenhouse. Progress report, November 30, 1979-February 28, 1980.** Jones, R.W. (South Dakota Univ., Vermillion (USA)). Feb 1980. Contract AC02-79CS30242. 17p. Dep. NTIS, PC A02/MF A01.

Research is being conducted on the attached-greenhouse type of passive solar heating system in the north-central region. The thermal performance of attached-greenhouse buildings is being analyzed in order to determine the component sizes and configurations which optimize performance. The analytical method is dynamic computer simulation using a thermal network model and actual hourly meteorological and solar radiation data from the north-central region. Progress has consisted of a large number of computer simulation runs resulting in performance estimates for certain designs. Preliminary conclusions on design guidelines are suggested by the results. The overall aim of the project is the development of specific design guidelines useful to architects and builders.

20369 (DOE/CS/31591—2) **Development of a solar desiccant dehumidifier. Second technical progress report.** Gunderson, M.E.; Hwang, K.C.; Railing, S.M.; Rousseau, J. (AiResearch Mfg. Co., Torrance, CA (USA)). 10 Nov 1978. Contract EG-77-C-03-1591. 93p. Dep. NTIS, PC A05/MF A01.

Research and development of a solar desiccant dehumidifier featuring a rotary bed of granular silica gel and a rotary regenerator for air conditioning is described. The results of the system optimization studies are presented. The studies involved an extensive investigation of the energy saving potential and economic viability of the solar desiccant dehumidifier in different locations in the United States. Conventional electric vapor compression, and solar absorption and Rankine systems also were investigated for comparison. In general, it was found that the solar desiccant equipment, either by

itself or in a hybrid system with an electric vapor compression air conditioner, is economically viable for all three locations considered. Substantial energy savings can be effected as well. Seal tests done at AiResearch to develop practical dynamic air seals are described. Leakage and friction tests were performed on a variety of material combinations and configurations. Dacron felt and silicone rubber were found to give an acceptable combination of leakage, friction, and cost characteristics. As part of the commercialization studies for the desiccant equipment, a questionnaire was sent to residential air conditioning equipment distributors. The results of the questionnaire are presented. The specifications and drawings for the 1.5-ton prototype are included. (WHK)

20370 (DOE/CS/34135—6) **Solar atrium: a hybrid solar heating and cooling system. Technical progress report No. 6, December 19, 1978-March 19, 1979.** Ueland, M. (Ueland and Junker, Architects and Planners, Philadelphia, PA (USA)). 1979. Contract EG-77-G-04-4135. 11p. Dep. NTIS, PC A02/MF A01.

A program of applied research is described for the design, construction and monitoring of an innovative concept of solar heating and cooling called solar atrium adaptable to residences and smaller commercial and institutional buildings. It is designed to be constructed of materials and equipment that are economical and readily available. Progress on construction is reported. (MHR)

20371 (DOE/NASA/CR—161356) **Solar energy heating system design package for a single-family residence at New Castle, Pennsylvania.** (Honeywell, Inc., Minneapolis, MN (USA). Energy Resources Center). Aug 1977. Contract EX-76-A-29-1037. 190p. Dep. NTIS, PC A09/MF A01.

The design of a solar heating and hot water system for the New Castle Redevelopment Authority's single-family dwelling located at New Castle, Pennsylvania is described. Documentation submitted by the contractor for Government review of plans, specifications, cost trade studies and verification status for approval to commit the system to fabrication is presented. Also included are system integration drawings, major subsystems drawings, and architect's specifications and plans.

20372 (DOE/NASA/CR—161384) **Solar heating and hot water system installed at the Senior Citizen Center, Huntsville, Alabama.** (City of Huntsville, AL (USA)). Feb 1980. Contract EX-76-A-29-1037;EG-77-A-01-4071. 145p. Dep. NTIS, PC A07/MF A01.

Information is provided on the solar energy system installed at the Huntsville Senior Citizen Center. The solar space heating and hot water facility and the project involved in its construction are described in considerable detail and detailed drawings of the complete system and discussions of the planning, the hardware, recommendations, and other pertinent information are included. The facility was designed to provide 85 percent of the hot water and 85 percent of the space heating requirements. Two important factors concerning this project for commercial demonstration are the successful use of silicon oil as a heat transfer fluid and the architecturally aesthetic impact of a large solar energy system as a visual centerpoint. There is no overheat or freeze protection due to the characteristics of the silicon oil and the design of the system. Construction proceeded on schedule with no cost overruns. It is designed to be relatively free of scheduled maintenance, and has experienced practically no problems.

20373 (DOE/R5/10128—1) **Urban Options Solar Greenhouse Project. Semi-annual technical progress report.** Cipparone, L. (Urban Options, East Lansing, MI (USA)). 13 Mar 1980. Contract FG02-79R510128. 11p. Dep. NTIS, PC A02/MF A01.

The design changes and construction of the Urban Options Solar Greenhouse are described. The greenhouse performance and horticultural and educational activities are discussed. (MHR)

20374 (EPRI-ER—1282-SR) **Manual and programmable calculator methods for sizing solar energy systems.** Barlow, R.S. (Electric Power Research Inst., Palo Alto, CA (USA)). Dec 1979. 79p. Dep. NTIS, PC A05/MF A01.

The important characteristics, features, and limitations of manual methods and programmable calculator software for sizing active or passive solar energy systems and predicting their performance are described. The intent is to provide utilities with useful information that will facilitate sound choices of solar calculation methods to be used in responding to the National Energy Act. The major issues relating to manual solar calculation methods are discussed. General information on each method is given in easily used matrices. Critical reviews, as well as sources and costs, are given in a one-page summary for each method. Throughout the text, an effort is made to identify those methods that will be most useful, and overall conclusions regarding this concern are included.

20375 (EUR—6667) **Analysis on heat pump assisted solar energy air heating systems: CEC-solar energy R and D Programme. Final report.** (Louvain Univ., Heverlee (Belgium). Lab. voor Warmteoverdracht en Reaktorkunde). 1980. 154p. Dep. NTIS (US Sales Only), PC A08/MF A01.

A study is made of the performance of heat pump assisted solar energy air heating systems. Based upon experimental observation of the performance of the major components of such systems (solar collectors, heat pump, storage reservoirs) computation models are developed which allow the year-round energy savings of the systems to be calculated. In the present study these calculations are performed by referring to a standard meteorological year in Belgium. Considerable attention is given to the heat pump characteristics. Systems without storage reservoir as well as with one or two reservoirs are studied. The effects of system parameters as heat pump size, collector area, storage capacity, etc., upon system performance are investigated. It is found that heat pump assisted solar heating systems should have one storage reservoir and should allow for the use of outside air during heat pump operation. The relative cost of electrical energy and auxiliary energy is very important in estimating the impact of the heat pump. The average coefficient of performance of the heat pump is found to be 2. Directions are indicated in which research should be continued to further study the effects of heat pumps applied to solar systems.

20376 (EUR—6700) **Numerical simulation of solar heating of buildings. Final report.** Coffe, G.; Jannot, M.; Pellerin, J.F. (Societe Bertin et Compagnie, 78 - Plaisir (France)). 1980. 77p. Dep. NTIS (US Sales Only), PC A05/MF A01.

This study is divided into two parts: First, the thermal modelling of a solar + electric heated building is presented; mathematical equations are established; numerical calculations are analyzed; and a calculation code in FORTRAN V is set down. Second, this calculation code was used to study the thermal performances of the solar + electric heated building in three European climates: Copenhagen (56° north latitude - Denmark), Trappes (48° north latitude - France), and Carpentras (44° north latitude - France).

20377 (LA-UR—80-701) **Optimum mix of conservation and solar energy in buildings.** Balcomb, J.D. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 6p. (CONF-800604—7). Dep. NTIS, PC A02/MF A01.

From American section of the International Solar Energy Society conference; Phoenix, AZ, USA (2 Jun 1980).

A methodology is developed for optimally allocating resources between conservation and solar strategies in building design. Formulas are presented for a constrained optimum in which the initial investment is limited. The procedure is amenable to hand analysis if tables are available which give the Solar Savings Fraction as a function of the Load Collector Ratio for the locality. A numerical example is given.

20378 (LA-UR—80-702) **Rules of thumb for passive solar heating.** Balcomb, J.D. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 6p. (CONF-800604—8). Dep. NTIS, PC A02/MF A01.

From American section of the International Solar Energy Society conference; Phoenix, AZ, USA (2 Jun 1980).

Rules of thumb are given for passive solar systems for: (1) sizing solar glazing for 219 cities, (2) sizing thermal storage mass, and (3) building orientation.

20379 (LA-UR—80-746) **Energy savings obtainable through passive solar techniques.** Balcomb, J.D. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 13p. (CONF-800524—1). Dep. NTIS, PC A02/MF A01.

From International congress on building energy management; Povoa de Varzim, Portugal (12 May 1980).

A passive solar energy system is one in which the thermal energy flow is by natural means, that is by radiation, conduction, or natural convection. The purpose of the paper is to provide a survey of passive solar heating experience, especially in the US. Design approaches are reviewed and examples shown. Misconceptions are discussed. Advantages are listed. The Los Alamos program of performance simulation and evaluation is described and a simplified method of performance estimation is outlined.

20380 (NBSIR—79-1923) **Residential Solar Data Center grant reports.** Christopher, P.M.; Aronoff, M.J. (National Bureau of Standards, Washington, DC (USA)). Sep 1979. 73p. NTIS.

The Residential Solar Data Center project staff in the Center for Building Technology, National Bureau of Standards, is responsible for the establishment and operation of a computerized database containing non-instrumented residential data generated by the Solar Heating and Cooling Demonstration Program sponsored by the Department of Energy and the Department of Housing and Urban Development (HUD). This document includes computer reports of data contained in the Grant file, one of six computer files comprising the database. These computer reports contain data recorded on applications submitted to HUD by organizations or individual builders applying for grants to build solar energy systems in new and/or

existing homes. To date, approximately 450 grants have been awarded in the first four award cycles.

20381 (NESEC—7) **Solar assessment of non-federal public buildings in the northeast region.** (Northeast Solar Energy Center, Boston, MA (USA)). Apr 1980. Contract AC02-80CS30149. 218p. Dep. NTIS, PC A10/MF A01.

The activities and results of the Non-Federal Public Buildings Assessment are presented. The thrust of the project was solely on domestic hot water and space heating applications, with energy provided by active or passive solar thermal, wood, and possibly, wind. Individual state summaries are included which were abstracted from the final reports submitted by the states. Three appendices are included as examples of the delivered results of this project. The examples shown demonstrate three different approaches to this assessment and are typical of the accomplishments in the other states. The New Hampshire example is that of a consultant architectural and engineering firm performing the assessment. The New York example is for a self-assessment performed by the building manager. The Pennsylvania example is of data collection by the individual building manager with judgment made by the State Energy Office upon return of data. (MHR)

20382 (PB—297882) **Commercializing solar heating: a national strategy needed. Report to the congress.** (General Accounting Office, Washington, DC (USA). Energy and Minerals Div.). 20 Jul 1979. 84p. NTIS PC A05/MF A01.

This report discusses the adequacy of the Nation's efforts to commercialize solar heating systems. Accordingly, this report discusses (1) constraints facing the use of solar heating systems, (2) the effectiveness of ongoing efforts to overcome these constraints, and (3) the potential effectiveness of the National Energy Act in encouraging the use of solar heating systems.

20383 (PB—298238) **Solar energy. Volume II. The potential for the solar heating and cooling of buildings.** Berkowitz, J.B.; Horne, R.A. (Little (Arthur D.), Inc., Cambridge, MA (USA)). 30 Jun 1976. Contract NSF-C835. 303p. NTIS, PC A14/MF A01.

The design and performance of several solar houses, schools, and an office building are presented. The technical and economic feasibility of solar heating and cooling is addressed. Cost analyses for single family residences indicate that solar systems are non-competitive against oil or natural gas, but are competitive against electric resistance heating. The impact of solar heating and cooling on the physical environment would be favorable. Model projections to the year 2010 of the impact of market penetration by solar energy indicates a direct energy savings of 1.5 quadrillion Btu/yr, an employment by the new industry of about 100,000 persons, a reduction in oxides of sulfur air pollution by slightly less than 300,000 tons/yr and of particulates by 50,000 tons/yr. The growth of solar energy will affect building codes, standards, zoning, and financing and legal issues such as sun rights will emerge.

20384 (SAN—1591-3) **Development of a solar desiccant dehumidifier. Third technical progress report.** Gunderson, M.E. (AiResearch Mfg. Co., Los Angeles, CA (USA)). 12 Jun 1979. Contract EG-77-C-03-1591. 80p. Dep. NTIS, PC A05/MF A01.

This program is aimed at the development of a solar desiccant dehumidifier featuring a rotary bed of granular silica gel and a rotary regenerator. Design, fabrication, performance, commercialization studies, and test stand development are described in detail. (WHK)

20385 (SERI/TP—351-431, pp 1-5) **System analysis for multizone buildings.** Ottenstein, J.; Mitchell, J.W.; Beckman, W.A. (Univ. of Wisconsin, Madison). 1980.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

An analysis of the application of solar energy to multizone buildings is performed using TRNSYS with a model of a variable air volume system formulated for the purpose. The model includes conventional heating and cooling equipment, heat recovery chiller, economizer cycle, and storage tank. Solar collectors and an absorption chiller are then added to the building. The results lead to a number of conclusions about the feasibility of solar energy systems for multizone buildings.

20386 (SERI/TP—351-431, pp 13-18) **Systems analysis of the thermal peformance of operating systems.** Ward, D.S. (Colorado State Univ., Fort Collins). 1980.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

The principal objective of any design method or system analysis procedure is to present predicted or measured performance in a unambiguous format so that potential improvements in the operation of the system, comparisons of different operting modes, and other operating experience can be realistically evaluated. An important qualification is the availability of sufficient detail in the design method and/or sufficient data in the system's analysis to allow for definitive conclusions on the relative merits of different solar designs and/or operating conditions. A performance evaluation criteria which the author considers as the minimal requirement for a realistic analysis of the operating performance of a solar heating and cooling system is presented and discussed.

20387 (SERI/TP—351-431, pp 27-31) **Comparison of actual and simulated performance of the Arlington house system.** Daugherty, M.A.; Mitchell, J.W.; Duffie, J.A. (Univ. of Wisconsin, Madison). 1980.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

The performance of a solar energy system on a small residential building at Arlington has been evaluated through experiment and simulation. The house system incorporates Owens-Illinois evacuated tabular collectors with air as the working fluid. A large pebbble bed storage unit is used to store off-peak electric auxiliary and solar energy. Auxiliary energy is supplied by the utility only between 10 PM and 8 AM. Domestic hot water is provided by an air-water heat exchanger supplying a preheat tank. Data for two periods has been analyzed in detail to determine actual system performance. TRNSYS simulations have then been done for the same periods using the measured solar radiation on a horizontal plane and the measured ambient temperature. Leakage and duct losses are found to have a major effect on the results, and these are included in the simulations. Comparisons are made of integrated energy quantities and rock bed temperatures. The data and the simulations agree quite closely for the two data periods simulated.

20388 (SERI/TP—351-431, pp 33-38) **Conservation and solar: working together.** Balcomb, J.D. (Los Alamos Scientific Lab., NM). 1980.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

Although it is often stated that proper building design consists of first doing energy conservation and then doing solar, a methodology for best allocating limited resources between the two has not been developed. This article provides a simple procedure, based on local cost estimates and local weather data, which minimizes annual auxiliary building heat. The procedure is then extended to identify the point of minimum life-cycle dollar savings given assumptions of future fuel costs, financing, discounting to present value, inflation rates, resale values, taxes, etc. The methodology can be used to identify the minimum net energy required of a building considering the energy embodied in construction materials, energy expended in construction, and operating energy over an assumed lifetime. Numerical examples are given.

20389 (SERI/TP—351-431, pp 39-45) **Simulation and cost optimization of the solar assisted annual cycle Energy System (ACES).** Mac Arthur, J.W. (Honeywell Inc., Minneapolis, MN); Finn-Carlson, D.W.; Nguyen, K.H. 1980.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

A detailed, dynamic computer simulation has been developed to determine the cost optimized solar assisted Annual Cycle Energy System (ACES). This model evaluates the two systems that form the core of recognized quality ACES: the ice-maker heat pump and the dual source evaporator. In addition to simulating the ACES system, the computer program can simulate combinations of four conventional heating and cooling systems: gas fired furnace, oil fired furnace, air-to-air heat pump, or a central heating/cooling (electric) system. This capability permits a meaningful evaluation of the cost-effectiveness of the ACES system, based on the present worth of all cash outlays, discounted over the appropriate system lifetime. Included in the economic model is time-of-day pricing, a feature which provides a realistic evaluation of the effect of thermal storage on life cycle costs.

20390 (SERI/TP—351-431, pp 59-62) **Enhancement of performance of active solar systems by optimal control and system identification techniques.** Baer, C.A. (Colorado State Univ., Fort Collins); Pryor, D.V.; Winn, C.B.; Lantz, L. 1980.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

Optimal controllers of the second kind can provide significant increases in the amount of useful energy gained as compared to that provided by bang-bang controllers. Theoretical increases range from 5% up to over 50% depending upon the climatological data used. The purpose of this paper is (1) to investigate practical considerations which may cut into this increased performance and (2) to offer possible solutions to these implementation type problems.

20391 (SERI/TP—351-431, pp 63-68) **Analytic techniques for development of control straegies for passive solar building.** Herczfeld, P.R. (Drexel Univ., Philadelphia, PA); Fischl, R.; Fischer, M. 1980.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

A formalism is developed using analytic techniques, for incorating the control probelm of passive solar energy systems with the

design procedures. The model emphasizes structures consisting of composite walls and demonstrates how their dynamics are related to the control. The general approach is well suited for application of classical frequency domain control theory. The theory is augumented by several examples, which demonstrates the interaction between the control functions and the building dynamics. The frequency domain analysis provides physical insight into the thermal response of passive solar buildings. It is shown that compoiste wall structures can reduce the undesired high daily temerature swings of building without effecting the overall heat gain.

20392 (SERI/TP—351-431, pp 155-158) **Implementation of an optimal controller of the second kind.** Winn, R.C.; Winn, C.B. (Colorado State Univ., Fort Collins). 1980.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

An optimal controller of the second kind is one which maximizes the difference between the useful energy collected by a solar heating system and the associated pumping costs. An analytical solution to the optimization problem is presented, and the method of implementing the micro-processor based optimal controller is described. The optimal controller built for Solar House II at Colorado State University, which has an air solar heating system, is described. Comparisons of system performance for a bang-bang controller with a single stage fan, an optimal controller with an infinitely variable fan, and an optimal controller with a four stage fan are presented. Also, the effect of errors in system parameters on system performance is analyzed.

20393 (SERI/TP—351-431, pp 165-170) **Optimal identification of parameters in passive solar buildings.** Pryor, D.V.; Baer, C.A.; Winn, C.B. (Colorado State Univ., Fort Collins). 1980.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

The use of the Kalman filter in evaluating system parameters of passive solar systems is examined. Two basic applications of the filter are discussed, in one of which the filter was driven with simulated data, while in the other, data gathered at an experimental test station was used. Results from both applications are presented and discussed. In both cases, the Kalman technique was found to be of some use, although was not without some problems, particularly in the case where real data was used. Finally, suggestions are made for possibly correcting some of the noted short-comings of the results obtained in this study.

20394 (SERI/TP—351-431, pp 203-207) **Thermal implications of the City of Seattle energy code.** Emery, A.F.; Kippenhan, C.J.; Heerwagen, D.R. (Univ. of Washington, Seattle). 1980.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

Thermal analyses of single wall sections and of a simple room have been made with a large scale simulation code to determine under what conditions the special passive solar provisions in the recent City of Seattle, Washington buiilding code reflect what would be observed for structures exposed to typical coastal and semi-arid weather patterns. The results suggest that the reduction in U values permitted for heavy wall sections are somewhat optimistic and that the daily temperature changes estimated to occur in thermal masses located within the building envelope are overly generous for external walls and for internal frame walls and too small for internal concrete walls. The effects of external insolation on reducing effective winter U values is shown to be substantial and suggest that some provision be made to accommodate this in the code.

20395 (SERI/TP—351-431, pp 233-244) **Solar district heating model for an azimuth-tracking floating concentrator on a seasonal-heat-storage reservoir.** Cluff, C.B.; Kinney, R.B. (Univ. of Arizona, Tucson). 1980.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

The development of a computer model which sizes the floating concentrator and seasonal heat-storage reservoir needed to operate solar district-heating and-cooling systems is reported. A prediction of the water temperature variation with time in the storage reservoir is obtained using a Fourier series type analysis. The model has been applied to districts composed of 10, 50 and 250 individual residences. A 4459 m^2 (98,000 ft^2) circular collector on a 10.7 m (35 ft) deep reservoir will provide the 250-home subdivision with 100% of the space heating and domestic hot water in an average year. This is approximately 17.8 m^2 (192 ft^2) per home which is one-third that required without annual storage. This reduction in area should more than compensate for the cost of insulation and distribution of the hot water from the patented centralized collector system. A utility operated system would have the convenience and dependability that consumers are now experiencing with non-renewable sources of thermal energy.

20396 (SERI/TP—351-431, pp 251-257) **TRNSYS simulation of chemical heat pumps for solar heating, cooling, and storage.** Offenhartz, P.O'D. (EIC Corp., Newton, MA). 1980.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

TRNSYS-compatible subroutines for the simulation of various types of chemical heat pumps have been written and simulations for both heating and cooling are being performed for the Washington, DC climate. Direct comparisons between the H_2SO_4/H_2O, $CaCl_2/CH_3OH$, and NH_4NO_3/NH_3 chemical heat pumps are being carried out and, in the heating mode, comparisons with conventional hot water storage are being made. In all cases simulated, the solar collector is a fixed evacuated tube system. The performance of the H_2SO_4/H_2O and NH_4NO_3/NH_3 systems was found to be quite similar, although the ammonia-based system showed some potential problems due to high concentrations of NH_4NO_3 that cold lead to salt precipitation. The $CaCl_2/CH_3OH$ consistently indicated lower maximum solar collector temperatures, but at the cost of reduced coefficients of performance. In the cooling mode, which has been examined at some length, the reduced COP of the $CaCl_2/CH_3OH$ system was almost exactly balanced by the reduced collector performance (at higher operating temperatures) of the H_2SO_4/H_2O system. Thus, despite remarkably different designs, the two systems met almost exactly the same fraction of the cooling load with a given collector area. While this result is somewhat accidental - it depends on climate, collector performance, and, above all, on storage capacity - it indicates that differences between various chemical heat pump designs do not necessarily lead to major differences in performance.

20397 (SERI/TP—351-431, pp 265-271) **Computer modeling of air leakage in a solar air heating system.** Shingleton, J.G. (Mueller Associates, Inc., Baltimore, MD); Cassel, D.E.; McCabe, M.E. 1980.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

A detailed TRNSYS computer model developed to permit evaluation of the effects of air leaks on the performance of a solar air heating system is described. The model was developed to define reasonable limits of air leakage for specification in performance criteria for solar heating and cooling systems in commercial and residential buildings. Hour-by-hour simulations were performed for an entire heating season for various air leakage rates. Hourly simulation results are presented to demonstrate the immediate system effects (reduced collector outlet and house supply temperatures) that are the cause of long-term system performance degradation. Seasonal simulations performed with the model indicate that the elimination of all the measured air leakage results in a 19% reduction in auxiliary energy use. Short-term simulations show that collector and storage air leadage is accompanied by lower collector outlet and house supply temperatures, higher collector array operating efficiency, and increased auxiliary energy use.

20398 (SERI/TP—351-431, pp 273-277) **FCHART 4.0: The University of Wisconsin solar energy design program.** Mitchell, J.C. (Univ. of Wisconsin, Madison). 1980.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

The FCHART computer program utilizes several methods for the design of solar energy systems which have been developed at the University of Wisconsin during the last few years. These methods, which are outlined, allow convenient estimation of the long-term average performance of solar space heating, water heating, heat pump, and certain industrial process heating systems. In all cases, system performance is calculated from equipment characteristics and monthly average meterological data. The interactive program allows the user to describe the system to be analyzed easily and provide straightforward tables of performance results. Combining efficient methods of performance evaluation with system optimization and economic analysis routines, FCHART 4.0 is a convenient and powerful tool for engineers in the solar energy field.

20399 (SERI/TP—351-431, pp 279-284) **Simplified thermal performance simulation and economic analysis methodology for design of passive solar homes.** Icerman, L.; Myers, K.; Swift, A. (Washington Univ., St. Louis, MO). 1980.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

A simplified methodology is developed which consists of a computer simulation of the heat flow characteristics of a passive solar home for a variety of design parameters (e.g., window area, insulation levels, thermal mass) and site-specific factors (e.g., weather conditions, building orientation). Performance data from the thermal response simulation and unit cost estimates of passive design elements are incorporated into a linear programming optimization model to determine least-cost designs and to predict the corresponding heat flow characteristics. Preliminary results indicate that the linear programming model can predict heat flow characteristics of the optimal home designs to within a few percent of those obtainable from more expensively hourly simulation techniques. Application o"

this design methodology to a moderate-sized home in the Columbia, Missouri, area shows that many passive design elements and systems are highly cost effective in new home construction at current electric utility rates.

20400 (SERI/TP—351-431, pp 285-289) **Long-term solar cooling systems performance predictions via a simplified design method.** Anand, D.K.; Abarcar, R.B.; Allen, R.W. (Univ. of Maryland, College Park). 1980.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

A viable alternative to detailed computer simulation as a means of obtaining long-term solar cooling system performance is the correlation of numerous simulation results that cover a wide range of system parameters and weather conditions. The design method presented in this paper uses a solar cooling fraction, f/sub c/-chart which was derived from detailed SHASP (Solar Heating and Air Conditioning Simulation Programs) runs of a solar cooling system operating under varying real weather conditions obtaining in various cities selected for their reasonably good values of available insolation and expected cooling loads. The combinations of diverse climatic conditions and cooling demands insure the region independency of the resulting correlation.

20401 (SERI/TP—351-431, pp 291-296) **PACE - passive active conservation evaluator - a new computer program for building energy analysis.** Kurtz, J.; Groome, L. 1980.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

PACE is a computer program with wide analytical versatility currently being developed for the Solar Energy Research Institute (SERI). The version of the program currently being developed will provide comprehensive performance, economic, and financial analysis capability for active and passive residential solar energy applications. Ultimately, the program will include capability for analysis of conservation measures, thus allowing tradeoff analysis among conservation and solar options. The PACE program combines key elements of several popular existing calculation methods and programs in forming a composite umbrella program. These include the F-chart method for active system performance estimation, the Solar Load Ratio (SLR) method for passive performance estimation, and the RSVP/2 solar economic analysis program, PACE is a tool designed to serve a broad range of users and uses, both in the research/analysis field and in the residential building marketplace. It is a conversational interface program allowing it to be used easily by those unfamiliar with computer use. In addition, the structure of the program allows it to be used effectively by persons with greatly differing levels of solar knowledge. The program is described.

20402 (SERI/TP—351-431, pp 303-306) **Simplified solar heating system performance estimator for residential applications.** Pejsa, J.H. (Honeywell Inc., Minneapolis, MN). 1980.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

A Simplified Solar Heating System Estimator based on specific collector characteristics and system design can be derived for residential space heating applications. Within the lower 48 United States six solar regions are defined. Within each region, the solar energy available over the heating season is relatively consistent. Furthermore, regionally, there is a correlation between latitude and design load of a building and the expected annual space heating load. Described is the technique to derive regional algorithms for the space heating load and tc generate annual collector performance curves. The assumptions and limitations inherent in this simplified approach are also set forth.

20403 (SERI/TP—351-431, pp 308-310) **Extracting useful building performance characteristics without simulation.** Sebald, A.V. (Univ. of California, San Diego, La Jolla). 1980.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

Although simulation is a useful tool, it does not permit extraction of all the information embodied in a thermodynamic model. An alternative but complementary approach is discussed in which the model normally created for simulation is processed using Fourier Transforms to extract structural information which can be obtained without simulation. More importantly, such information is not produced by simulations. Simple existing computer algorithms can be used to accomplish the necessary processing even for large models (> 40 nodes). The resulting structural information is useful both to determine whether building performance is satisfactory and to indicate solution paths when it is not.

20404 (SERI/TP—351-431, pp 311-316) **Comparison of building thermal analysis methods.** Harrington, K.; Lydon, R.T. (Arga Associates, New Haven, CT). 1980.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

A guide to passive solar load models is developed based on the literature. Eight basic algorithms are identified. Each is characterized by four criteria with the user of the algorithm in mind. The criteria consist of the models base assumptions, computational costs, types of input and relevance of output to the stages of architectural design. Some concluding notes are made on the nature of test cells. The models include Bi-Nodal R-C, Eight Nodal R-C, Mini-Nodal R-C, Full-Nodal R-C, Heat Balance - Dynamic Matrix, Heat Balance - Hybrid, Heat Balance - Fixed Matrix, and Weighting Factors. At least one example of each is given in the concluding table.

20405 (SERI/TP—351-431, pp 323-329) **Comparison of simulation and measured performance of the Suncatcher house design using SOLSIM and SOLEST.** Maeda, B.T.; Grant, P.W. (Davis Alternative Tech. Associates, CA). 1980.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

D.A.T.A.'s thermal analysis simulation program has been used to simulate the performance of the Suncatcher passive solar home design by Living Systems. The simulations of days in December, 1978, and November, 1979, are compared to actual monitored data of the Nittler/Maeda Suncatcher. In addition, long term data for 1978 is compared to a computerized simplified performance estimation procedure more appropriate for design evaluation of passive solar and energy conserving design. This estimation procedure evaluates passive solar heating, natural cooling, and domestic hot water performance. Simulation results appear to be in good general agreement with 2°C (4°F) differences in maximum temperatures.

20406 (SERI/TP—351-431, pp 331-336) **Simulation of passive-hybrid solar home with a user-accessible computer-based design tool.** Straub, D. (Ecotope Group, Seattle, WA); Browne, M.; Smith, O. 1980.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

Theoretical work regarding heat transfer processes in rockbin heat storage systems has progressed in the last few years. Computer algorithms have been developed which efficientiy solve the rockbin energ balance equations. Two of the most efficient and flexible theoretical formulations, one from the TRNSYS model and one designed for DOE by the Boeing Computer Services Company to be used as a component in a active systems model, have been incorporated into a designer-oriented computer model developed to simulate passive solar houses (SUNCAT). Appropriate controller logic and space conditioning lgorithms have been added to SUNCAT (now Ecotope Passive/Hybrid Solar Model) to allow it to model numerous types of passive/hybrid house combinations. The incorporation of these rockbin models into SUNCAT allows the designer to specify and size rockbins, determine the effect of different thermal connections between the rockbin and other spaces, and to see the effect of design changes on hybrid house performance over any selected time period. As an example, the yearly performance of a hybrid house is determined for three climates, Seattle, WA, Madison, WI, and Albuquerque, NM.

20407 (SERI/TP—351-431, pp 367-372) **Sensitivity analysis of solar assisted heat pump systems.** White, N.M. (Science Applications, Inc., McLean, VA); Morehouse, J.H.; Hughes, P.J.; Swanson, T.D. 1980.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

Space heating systems which combine the use of solar energy with an electric heat pump have been proposed as a practical approach to the cost effective utilization of solar energy. Numerous studies have been made comparing the performance of series type solar assisted heat pump (SAHP) systems, parallel type SAHP systems, stand-alone heat pumps and conventional fossil fired alternatives. Through utilization of previously developed thermal and economic models, areas for possible cost reduction and/or performance improvement in SAHP systems are identified. Major system components evaluated include collectors, heat pump, storage, heat exchangers, and controls. Variations in many of the parametric values of each of these components are evaluated. This study identifies the heat pump and solar collectors as the components with the greatest potential for technical improvement. For the heat pump, its capacity at design point, rate of change in capacity with increasing evaporator temperature, and minimum utilizable evaporator temperature are the principal parameters. For the collectors, their tau α and U/sub L/ are the principal parameters. The change in system performance due to specific parametric variations is quantified. The results of variations with only one parameter are used as a basis for studies involving multiple parametric variations. Costs associated with each change are also estimated. This permits computation of life-cycle costs for each alternative system design. The result of this work will be the identification of the most optimistic, but realistic, future SAHP designs.

20408 (SERI/TP—351-431, pp 383-388) **Results of systems simulation and economic analysis of a solar-powered turbocompressor heat pump.** Melikian, G.; Rhodes, B.W.; Obee, T.N. (United Tech. Research Center, East Hartford, CT). 1980.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

Since 1974, United Technologies has been actively engaged in the design, development and demonstration of solar-powered Rankine cycle heating and coolig systems for building applications. Under a recent DOE contract, UTC has built and tested an 18-ton cooling capacity, 500,000 Btu/hr heat pump over a wide range of operating conditions simulating an actual building installation. To assist in the heat pump design and analysis, UTRC has developed and used several comprehensive system simulation and economic analysis programs. Collector array size, storage tank volume and control strategies were evaluated with these procedures. Typical results of the system simulations for buildings in six selected geographical regions are described and the economic potential for such a system is illustrated. The impact of variations in projected fuel price and component cost level on the UTC system economic potential (i.e., return-on-investment, payback period, etc) is shown in detail.

20409 (SERI/TP—351-431, pp 453-456) **Comparative analysis and evaluation by test of solar heating and cooling system computer programs.** Merriam, R.L. (Arthur D. Little, Inc., Cambride, MA); Purcell, G.G. 1980.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

An analysis, test and comprative evaluation of solar heating and cooling programs has been undertaken to establish their usefulness to problems of interest to electric utilities. From over 31 identified available programs, eleven were selected for detailed analysis to establish their range of applications and intended capabilities. Based on program ratings relative to specific categories of applications, four programs were selected for testing. Test cases were defined for three building types: single family dwelling, light commercial building and a heavy commercial structure. Performance predictions were carried out for conventional HVAC systems, passive solar design options, active solar options and variations of these to examine the sensitivity in predictions to various design assumptions. The sensitivity analysis provided a means for assessing the probable accuracy of the programs relative to the applications explored. All programs were tested by a single individual to minimize user-related differences in sults. However, inherent differences in the programs' intended capabilities (features considered, etc.) precluded exact comparisons since differeing compromises specific to the individual programs were required to apply the programs to the defined test problems. Although good agreement was obtained between the predicted weekly or monthly loads, the hourly loads and demands were found to be significantly different. The programs were also found to differ substantially in the requirements imposed on the user and in the processing times.

20410 (SOLAR/0802—79/01) **Active solar energy system design practice manual.** (Ehrenkrantz Group, New York (USA); Mueller Associates, Inc., Baltimore, MD (USA)). Oct 1979. Contract EG-77-C-01-2522. 222p. Dep. NTIS, PC A10/MF A01.

This manual is divided into liquid and air systems. The following are covered: collectors, collector arrays, mounting and support, storage, dampers, leakage concerns, safety and protection, and other equipment. (MHR)

20411 (SOLAR/2010—79/60) **Solar project cost report for Area Health Education Center, Charlotte, North Carolina.** (Mueller Associates, Inc., Baltimore, MD (USA)). Sep 1979. Contract EG-77-C-01-2522. 34p. Dep. NTIS, PC A03/MF A01.

Detailed cost information is reported for the Area Health Education Center (AHEC) project located in Charlotte, North Carolina. The solar energy system supplies space heating and service hot water for approximately 65,000 ft^2 of office space, classrooms, and library in a six story building in a hospital complex using 4,020 ft^2 of collectors (3,950 ft^2 net). Solar heated water is stored in an underground 6,000 gallon hot water storage tank. The construction costs of this solar project are presented. Category costs are listed by materials, direct labor, and subcontract costs. The subcontract costs include materials, labor, overhead and profit for insulation, control and minor subcontractors. The installed cost of the system was $180,200 not including general contractor, mechanical subcontractor, and general construction subcontractor overhead and profit and general and administrative costs.

20412 (SOLAR/2019—79/60) **Solar project cost report for Mount Rushmore National Memorial Visitors' Center, Keystone, South Dakota.** Hale, H.J. (Mueller Associates, Inc., Baltimore, MD (USA)). May 1979. Contract EG-77-C-01-2522. 36p. Dep. NTIS, PC A03/MF A01.

Cost information is reported for the solar space heating and cooling project at the Mount Rushmore National Memorial Visitors' Center in Keystone, South Dakota. The retrofit solar energy system provides space heating for the entire visitors' center building and space cooling for the center observation room. The system utilizes six (6) banks of solar collectors with a net area of 1,725 square feet, mounted facing south on the east sloping roof in a sawtooth configuration. The collectors are double glazed and have copper absorber plates with a selective surface. Storage capacity is 3,000 gallons and is provided by a steel storage tank with fiberglass insulation. Solar space heating is accomplished by a solar coil in the air handling unit. Solar space cooling is provided by 3 three-ton absorption chillers and a coil in the air handling unit. The absorption chillers and storage tank are located in a solar mechanical room retrofit against the existing building. The construction costs of this solar space heating and cooling project are presented in this report. Category costs are listed by materials, labor, and subcontract cost. The installed cost of the system was $112,925, in 1977 dollars, not including general contractor and construction manager's overhead and profit, engineering fees, and general and administrative costs.

20413 (SOLAR/2033—79/60) **Solar project cost report for Telex Communications, Inc. Assembly Plant, Blue Earth, Minnesota.** (Mueller Associates, Inc., Baltimore, MD (USA)). Jul 1979. Contract EG-77-C-01-2522. 34p. Dep. NTIS, PC A03/MF A01.

Detailed cost information is reported for the solar space heating project at the Telex Assembly Plant in Blue Earth, Minnesota. The system utilizes 360 ITC, flat plate liquid collectors having a net aperture area of 10,700 square feet. The collectors are mounted in 10 rows on ground level and are located across a parking lot from the plant building. The system provides space heating to the entire building. Solar energy is stored in a 20,000 gallon steel water tank which is located above grade inside the plant. Electric heaters provide the auxiliary energy. The construction costs of this solar space heating system are presented. Category costs are listed for Telex, general contractor's materials, general contractor's labor, and subcontract costs. The subcontract costs include materials, labor, and overhead and profit for the insulation, controls, and electrical power subystems. The construction cost for this project was $374,170 not including general contractor overhead and profit and general and administrative costs. (MHR)

20414 (SOLAR/2069—79/60) **Solar project cost report for DuCat Investments, Inc. warehouse, Kansas City, Kansas.** (Mueller Associates, Inc., Baltimore, MD (USA)). Aug 1979. Contract EG-77-A-01-4079;EG-77-C-01-2522. 32p. Dep. NTIS, PC A03/MF A01.

Installation cost information is provided for the DuCat Investments, Inc., warehouse solar space heating system located in Kansas City, Kansas. The solar energy system heats approximately 80 percent of this 48,800 square foot warehouse and office building. The system utilizes 7000 square feet of Solaron solar collectors in a sawtooth array on the building roof. Each row of 20 collectors provides heating to an 80 foot by 24 foot bay in the warehouse. Storage is provided by the warehouse materials themselves, while auxiliary energy is provided by an electric heater in each bay. There is no solar service hot water system. The construction costs of this solar heating project are presented in this report. Category costs are listed by materials and direct labor costs.

20415 (SOLAR/2070—79/60) **Solar project cost report for First Baptist Church, Aberdeen, South Dakota.** (Mueller Associates, Inc., Baltimore, MD (USA)). May 1979. Contract EG-77-A-03-1510;EG-77-C-01-2522. 34p. Dep. NTIS, PC A03/MF A01.

Installation cost information is reported for the First Baptist Church solar space heating and service water heating project located in Aberdeen, South Dakota. The solar energy system provides heat to the main worship center in the church and to the building service hot water system. The balance of the building is heated by an electric-fired hydronic baseboard heating system that also provides auxiliary energy to the solar energy system. The system utilizes air type collectors with a total net area of 1260 square feet. They are mounted directly on the roof of the worship center in a planar array. The collectors are connected in 9 groups of 8 collectors each in a series-parallel arrangement. Energy storage is provided by a rock bin, and service hot water storage is in a glass lined storage tank. The actual construction costs of the solar project are presented. Category costs are broken down to materials, labor and subcontracting costs. The total bare installed cost of the system was $50,075 which does not include overhead, profit or general and administrative costs of the Owner.

20416 **Double-shell solar house - high performance in a controversial package.** *Pop. Sci.;* **215**: No. 6, 54-57,116-117(Dec 1979).

The design features and performance of the double shell house which utilizes an attached south facing solar greenhouse and a continuous air plenum surrounding the house are discussed. The double shell is formed by a false north wall, a ceiling air plenum running the full width of the house, the greenhouse area, and a fully enclosed crawl space. Heated air from the greenhouse circulates through the ceiling air plenum, down the north wall and into the crawl space, then back into the greenhouse through a slatted floor.

Reverse circulation at night is designed to draw heat from the thermal mass storage in the foundation to heat the house. A revised theory of the heating cycle by the designer indicated that heating may be provided by multiple air flows in very thin layers that may encompass only portions of the air space. For summer cooling, heated air in the attic and greenhouse is vented and cooler air is introduced at the lowest point of the house, the crawl space. The air plenum completely buffers the interior from air infiltration and windows may be opened without breaking the air seal to the outside. Advantages and criticisms of the house design are reviewed.

AGRICULTURAL AND INDUSTRIAL PROCESS HEAT

REFER ALSO TO CITATION(S) 20344

20417 (GRI—78/0036) **Solar-augmented applications in industry: Phase I. Final report for 1979.** Williams, J.H.; Whitney, S.C.; Ball, H. (Insights West, Inc., Los Angeles, CA (USA)). Feb 1980. 136p. NTIS.

Through 200 Field Interviews, the process needs of a wide variety (over 150 different SIC's) of industries were examined and matched to existing solar hardware. Through a screening process using available annual insolation's relationship to process thermal needs a ranking of the Most Likely candidates for early entry application of solar was then developed. The institutional aspects of solar's use by industry were examined, as were generic solar collector performance variables. Significant feedback was obtained relative to the attitudes of industrial Plant Executives concerning solar. Results and conclusions are presented in detail. (WHK)

20418 (SERI/TP—351-431, pp 101-103) **Computer-aided solar thermal systems analyses for industrial process heat (IPH) applications.** Sundaram, S.; Roos, C.F.; Eldridge, B.G. (Jacob-Del Solar Systems, Inc., Pasadena, CA). 1980.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

We have developed a computer-simulation program to analyze our approach to the solar production of industrial process heat. Ours is a modular program - or system of programs - which offers several advantages over other simulation programs. It is easy to learn, requires little debugging and reduced run time, and provides its analysis at a lower cost than do other such programs developed by universities and the national laboratories to study solar thermal energy systems. It enables us to study all aspects of the solar production of industrial process heat, as well as space heating and cooling. The system, Solar Thermal Systems Simulation (STSS), uses an IBM System VM370 under CMS environment; it is written in FORTRAN IV. STSS, which includes main programs, subroutines and data files, will be validated and refined during the operation of a Jacobs-Del Solar Systems, Inc. project. This DOE-funded project, a demonstration of the solar production of industrial process steam, is being conducted at The Home Laundry in Pasadena, California.

20419 (SERI/TP—351-431, pp 425-429) **Technical and economic feasibility of solar ponds.** Lin, E.I.H. (Argonne National Lab., IL); Sha, W.T.; Soo, S.L. 1980.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

Analyses are presented to show that 1-acre salt-gradient solar pond can supply adequate heat to meet the grain drying and space heating requirements of a typical 2.02×10^8 m^2 (500-acre) Illinois farm. The specific corn-drying and hog-house heating needs of the 3.64×10^8 m^2 (900-acre) Fillman farm, Mazon, Illinois, are also shown to be amply sustainable by such a pond. Calculations are made to demonstrate that solar ponds are becoming economically competitive with fossil fuels. Their additional advantages, potential future uses and possible socio-economic impact are also discussed. Large-scale demonstration of solar ponds in agricultural applications is recommended.

20420 (SERI/TP—351-431, pp 463-468) **Comparison of the predicted performance of several solar system simulation codes for an industrial process heating system.** Freeman, T.L. (Altas Corp., Santa Cruz, CA). 1980.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

Comparisons of several active solar energy system simulation codes in the solution of a series of solar industrial process heat (IPH) problems are described. A typical solar IPH system was defined in sufficient detail to allow the particpants to provide input to their codes. Several collector types and two different load temperature requirements were investigated. A variety of modeling problems and differences were found and are discussed. A sensitivity study was performed on stratified tank modeling assumptions. After a series of iterative problem redefinitions and recomparisons of results, excellent overall agreement of both long and short term results was achieved. In the process, errors and shortcomings were identified in each of the codes and confidence in their accuracy was improved. The critical importance of user error was noted.

20421 (UCRL—84143) **Data acquisition for solar industrial process heat field tests.** Bush, G.; Kutscher, C. (California Univ., Livermore (USA). Lawrence Livermore Lab.; Solar Energy Research Inst., Golden, CO (USA)). 27 Mar 1980. Contract W-7405-ENG-48. 6p. (CONF-800604—1). Dep. NTIS, PC A02/MF A01.

From American section of the International Solar Energy Society conference; Phoenix, AZ, USA (2 Jun 1980).

Current solar industrial process heat field tests employ a variety of different types of data acquisition system. In general, data acquisition has been unreliable for these projects and, as a result, only a limited amount of performance data have been available. The problems encountered with transducers and data acquisition hardware, the advantages and disadvantages of various types of data acquisition systems are discussed, and includes a recommendation included as to which type is most suitable for monitoring industrial process heat field tests.

WATER HEATING

REFER ALSO TO CITATION(S) 20367, 20371, 20383, 20387, 20389, 20395, 20401, 20411, 20415, 20433

20422 (PB—80-802747) **Swimming pool design, construction, and operation (citations from the Engineering Index data base). Report for 1970-November 1979.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Dec 1979. 171p. NTIS PC N01/MF N01.

Design, construction, and operation of both indoor and outdoor swimming pools are discussed in abstracts from worldwide literature. Lighting, ventilation, dehumidification, filtration, chemical water treatment, and heating by electricity, gas, heat pumps, and solar energy are covered. (This updated bibliography contains 165 abstracts, 15 of which are new entries to the previous edition.)

20423 (SERI/TP—351-431, pp 53-57) **Control strategies for dual temperature solar hot water systems: an experimental comparison.** Wolfson, R.L.T.; Harvey, H.S. (Middlebury Coll., VT). 1980.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

Two identical solar collector systems were operated side by side for a 67 day period. Data acquisition and control of both systems were accomplished by a minicomputer. Each system included two storage tanks. One system's control strategy kept its two tanks at the same temperature, simulating a single tank. The other system employed a dual temperature strategy designed to allow greater flexibility in adjusting to varying insolation. The dual temperature strategy showed a modest 4% gain in energy delivered to a load.

20424 (SERI/TP—351-431, pp 125-130) **Economics of solar domestic hot water heaters in California.** Young, M.F.; Baughn, J.W. (Univ. of California, Davis). 1980.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

A comparison of the cost-effectiveness of four types of Solar domestic Hot Water (SDHW) systems is presented for five (5) locations throughout California using a net present worth (NPW) analysis with inflation. Computer simulations were previously performed to obtain the annual auxiliary energy requirements for a prescribed hot water load. The systems considered are two-tank thermosyphon (2TT) and pumped (2TP) and one-tank thermosyphon (1TT) and pumped (1TP). The accuracy of the computer simulation was previously verified by comparison to experimenal data on each of the four types of systems. It was found that when the SDHW systems are compared to a conventional electric hot water system, the NPW is always positive, with or without a tax credit, for the locations considered. The 2TT was found to have the highest NPW with the 2TP quite close. When a SDHW system is compared to a conventional natural gas hot water system the NPW is negative in most locations without a tax credit but for most of the systems the NPW becomes positive with the California 55% tax credit.

20425 (SERI/TP—351-431, pp 245-250) **Solar breadbox simulation using D.A.T.A.'s TBBX code.** Maeda, B.T.; Melzer, B. (Davis Alternative Tech. Associates, CA). 1980.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

D.A.T.A. has developed a computer code for the simulation of passive or integral solar hot water heaters, sometimes referred to as breadboxes. This code was derived from and is similar to a code used for simulating passive solar design of structures, denoted SOLSIM. Parametric simulations were run to evaluate operational influences on breadbox performance. Simulations were used to evaluate breadbox design for a breadbox installation project in Indio, California. Breadbox simulation indicates that convective/conductive gains in breadboxes are of equal magnitide to direct solar

absorption. Simulations are compared to a monitored breadbox system in Davis, California.

20426 (SOLAR/2016—79/60) **Solar project cost report for the Loudoun County Vocational-Technical Education Center, Leesburg, Virginia.** (Mueller Associates, Inc., Baltimore, MD (USA)). Jul 1979. Contract EX-76-C-01-2381;EG-77-C-01-2522. 34p. Dep. NTIS, PC A03/MF A01.

The solar energy system for the Loudoun County School in Leesburg, Virginia provides solar preheating of the domestic hot water supply for the Charles S. Monroe Vocational-Technical School. The system utilizes 34 double glazed, liquid, flat plate collectors in a ground mounted array with a total net area of 1169 square feet. A working fluid is circulated through a single wall heat exchanger in a 2056 gallon solar storage tank in the building mechanical room. On a demand for hot water and according to the system controls, water is circulated from this solar storage tank to a 1000 gallon hot water tank containing an electric immersion type auxiliary hot water heater. The actual as-built construction costs are presented. Category costs are listed by material, labor and subcontract cost. The installed cost of the system was $59,690 not including the overhead and profit of the mechanical subcontractor and the general and administrative expenses of the owner and his general contractor. (MHR)

20427 (SOLAR/2056—79/60) **Solar project cost report for Ingham County, Medical Care Facility, Okemos, Michigan.** (Mueller Associates, Inc., Baltimore, MD (USA)). Aug 1979. Contract EX-76-C-01-2382;EG-77-C-01-2522. 32p. Dep. NTIS, PC A03/MF A01.

The solar energy system supplies service hot water for a 204 bed medical and geriatric care facility with laundry and kitchen. The system was designed at the time the building was designed. The 9,374 ft^2 of collectors were manufactured by Revere Copper and Brass, Inc., and are mounted at grade level behind the building. Solar heated water for use in heating service water is stored in a 5000 gallon hot water storage tank. The heaviest use of hot water occurs during the day so the requirement for thermal storage is modest. The construction costs of this solar project are presented. Category costs are listed by materials, direct labor, ad subcontract costs. The subcontract costs include both materials, labor, overhead and profit for electrical, control and other minor subcontractors. The installed cost of the system was $312,825 not including prime contractor overhead and profit and general and administrative costs. (MHR)

OTHER

20428 (SAND—79-1656C) **Hydrogen actuated pump.** Northrup, C.J.M. Jr.; Heckes, A.A. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 20p. (CONF-800402—10). Dep. NTIS, PC A02/MF A01.

From International symposium on the properties and applications of metal hydrides; Colorado Springs, CO, USA (7 Apr 1980).

Hydrogen is used as the motive fluid in a novel water pump. The principle of operation of the pump is that a metal hydride may be heated to decompose the hydride to produce a metal alloy and hydrogen at elevated pressure. The high pressure hydrogen expands as it moves a flexible but impermeable diaphragm to produce a displacement capable of doing work. When the metal alloy powder is cooled the hydrogen is reabsorbed at the low (or expanded) pressure to return the system to its original condition. A laboratory prototype pump is shown and its thermal efficiency discussed. In practice, the laboratory prototype had a thermal efficiency of 2.4% and with simple design improvements is calculated to be capable of an efficiency of 5%. This compares well with actual Rankine engines which have an efficiency of 5% under similar operating conditions. An efficient metal hydride pump (or engine) may be designed which uses a relatively small temperature gradient between the heat source and the heat sink (80°C and 20°C, respectively). The basic simplicity of the hydride engine and its ability to operate efficiently at modest temperatures allows ordinary equipment and ordinary technology to be employed. Also, the energy sources to power this engine may be low temperature heat sources such as flat plate solar collectors or waste process heat.

SOLAR COLLECTORS AND CONCENTRATORS

REFER ALSO TO CITATION(S) 20341, 20347, 20398, 20410, 20903

20429 (ALO—4291-2) **Need for and evaluation of hail protection devices for solar flat plate collectors. Final report, June 1978-March 1980.** Armstrong, P.R.; Cox, M.; de Winter, F. (Atlas Corp., Santa Clara, CA (USA)). Mar 1980. Contract EM-78-C-04-4291. 58p. Dep. NTIS, PC A04/MF A01.

A brief summary of the hail risk work previously done under this contract is given, and a summary evaluation of hail impact resistance standards currently being developed is presented. Simulated hail impact test data, field data, and the impact resistance of commercially available glazings are discussed. The use of screens for protection against hail and the threat of vandalism to solar flat plate collectors are discussed. (WHK)

20430 (CONF-791021—3) **Plasma-sprayed coatings for very high temperature solar absorbers.** Schreyer, J.M.; Hays, R.A.; Schmitt, C.R.; Farwell, D. (Oak Ridge National Lab., TN (USA); White Sands Missile Range, NM (USA); Oak Ridge Y-12 Plant, TN (USA)). 1979. Contract W-7405-ENG-26. 10p. Dep. NTIS, PC A02/MF A01.

From 2. American Electroplaters Society symposium on coatings for solar collectors; St Louis, MO, USA (16 Oct 1979).

Plasma-sprayed coatings on steel plates were tested at the White Sands Solar Facility at temperatures from 200°C to 1000°C. Analysis of the specimens before and after testing showed erbium dodecaboride (ErB_{12}), yttrium hexaboride (YB_6), titanium diboride (TiB_2), and chromium oxide (Cr_2O_3) to be stable above 600°C. A heat balance on the water-cooled specimens of these coatings showed 71% to 97% heat recovery efficiency.

20431 (DOE/EIA—0174(79/2)) **Solar collector manufacturing activity, July-December 1979. Energy data report.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Mar 1979. 51p. Dep. NTIS, PC A04/MF A01.

Statistics on solar collector and solar cell manufacturing in the US are presented. Total shipments of solar thermal collectors during the second half of 1979 were 7.39 million square feet produced by 247 manufacturers (includes 48 nonrespondents). Compared to the previous 6-month period, producer shipments increased by 0.44 million square feet. Compared to second half of 1978 total, producer shipments increased by 2.81 million square feet. Producer shipments appear to be resuming the higher growth rates experienced prior to the second half of 1978. Total shipments for 1979 were 14.34 million square feet, 3.48 million square feet more than during 1978. Shipments by photovoltaic manufacturers during the second half of 1979 totaled 772 peak kilowatts. During the second half of 1979, low-temperature collectors accounted for 55 percent of producer shipments of all types of collectors; ninety percent of low-temperature collectors were used for pool heating; forty-two percent of producer shipments were medium-temperature solar collectors, of which 84 percent used liquid heat transfer media; sixty percent of medium-temperature liquid collectors were used to produce domestic hot water; companies headquartered in 5 states (California, Florida, Illinois, New Jersey, and New York) accounted for 85 percent of the total square footage produced; and companies headquartered in California, Florida, New York, and New Jersey accounted for 98 percent of the low-temperature collectors produced. Addresses of manufacturers and importers of solar collectors are included.

20432 (DSE—5359-T2) **Solar collectors: Technical progress report No. 2, 5 March 1979-5 December 1979.** Baum, B.; Binette, M. (Springborn Labs., Inc., Enfield, CT (USA)). 14 Mar 1980. Contract EM-78-C-04-5359. 38p. Dep. NTIS, PC A03/MF A01.

The following work is reviewed: accelerated ultraviolet exposure of glazing and housing materials, the evaluation of ultraviolet protective coatings and films, and investigation of antireflective coatings.

20433 (EMD—78-2125) **Development of a low-cost non-tracking heat pipe concentrating collector.** Feldman, K.T. Jr.; Noreen, D.L. (New Mexico State Univ., Las Cruces (USA). New Mexico Energy Inst.). Jul 1979. 158p. (NMEI—23). New Mexico Energy State Univ., Las Cruces, NM.

A solar water heater which uses a multi-heat-pipe energy absorber is proposed. In the absorber configuration, wickless heat pipes which rely on only gravity and a puddle-flow mechanism are used. In order to design an energy absorber with sufficient heat transfer capability, the performance of a puddle-flow gravity-assisted heat pipe is theoretically investigated. Three low-temperature heat pipe working fluids were considered in this analysis. The maximum heat transport capability of methanol, water, and Freon-11 heat pipes was investigated. The relationship between various heat pipe parameters and axial heat transport capability is discussed. To determine the performance of a solar water heater which uses a multi-heat-pipe energy absorber, a theoretical model is developed and experimentally validated. The collection efficiency is found to vary markedly with the number of energy absorber heat pipes, coating emittance, and the ambient weather cycle.

20434 (NP—24070) **Use of the gravity field to shape large linear solar concentrators.** Salvini, G.; Visentin, R. (Rome Univ. (Italy). Ist. di Fisica; Istituto Nazionale di Fisica Nucleare, Rome (Italy)). 5 Sep 1977. 11p. Dep. NTIS (US Sales Only), PC A02/MF A01.

Equations for designing large cylindrical east-west parabolic mirrors are presented and discussed. The concentrator proposed is made of long strips of plane mirrors and will be folded up during high winds. (WHK)

20435 (PNL-SA—7692) **Properties of low cost, high volume glasses.** Lind, M.A.; Hartman, J.S.; Buckwalter, C.Q. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1979. Contract EY-76-C-06-1830. 7p. (CONF-790838—6). Dep. NTIS, PC A02/MF A01.

From 23. annual international symposium of the Society of Photographic Instrumentation Engineers; San Diego, CA, USA (27 Aug 1979).

The properties of new and weathered samples of low cost, high volume glasses have been studied to determine their usefulness for solar energy applications. Glasses of varying compositions produced by float, drawn, rolled fusion, and twin ground techniques were examined. Spectral transmittance and reflectance were measured and solar weighted values calculated. Laser raytrace techniques were used to evaluate surface parallelism and bulk homogeneity. Compositional changes were examined with scanning electron microscopy, x-ray fluorescence, and Auger electron spectroscopy. These techniques were used in conjunction with ellipsometry to study the surface effects associated with weathering.

20436 (SAND—79-2032) **Analysis of the influence of geography and weather on parabolic trough solar collector design.** Treadwell, G.W.; Grandjean, N.R.; Biggs, F. (Sandia Labs., Albuquerque, NM (USA)). Mar 1980. Contract EY-76-C-04-0789. 28p. Dep. NTIS, PC A03/MF A01.

The potential performance of single-axis tracking parabolic trough solar collectors as a function of optical energy distribution and receiver size has been calculated for eleven sites using typical meteorological year input data. A simulation based on the SOLTES code was developed which includes the three-dimensional features of a parabolic trough and calculates the thermooptical tradeoffs. The capability of the thermooptical model has been confirmed by the comparison of calculated results with the experimental results from an all-day test of a parabolic trough. The results from this eleven-site analysis indicate a potential performance superiority of a north-south horizontal axis trough and, in addition, a high quality (optical error, σ/sub system/ $\leqq$ 0.007 radian) collector should be of the same geometric design for all of the sites investigated and probably for all regions of the country.

20437 (SAND—80-0801C) **Concentrating solar collector test results.** Dudley, V.E.; Workhoven, R.M. (EG and G, Inc., Albuquerque, NM (USA); Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 5p. (CONF-800604—5). Dep. NTIS, PC A02/MF A01.

From American section of the International Solar Energy Society conference; Phoenix, AZ, USA (2 Jun 1980).

Some of the results obtained from three years of testing concentrating solar collectors at Sandia National Laboratories are summarized. Efficiency and thermal loss test data is shown for 16 collectors from 11 different manufacturers.

20438 (SERI/TP—351-431, pp 69-74) **Solar flat plate collector control system sensitivity analysis.** Herczfeld, P.R.; Fischl, R.; Konyk, S. Jr. (Drexel Univ., Philadelphia, PA). 1980.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

This paper is concerned with problems related to the implementation of on/off controllers. A dynamic collector loop model is used to investigate the controller performance in terms of the sensitivity of pump cycling and net energy collected with respect to control set points, flow rate, system parameters and climatic conditions. Criteria are developed for the selection of the control set points in terms of system parameters such as time constants, flow rate, and climatic conditions. Finally the effect of the sensor location on the conroller action is investigated.

20439 (SERI/TR—351-494) **Analysis of solar collector array systems using thermography.** Eden, A. (Solar Energy Research Inst., Golden, CO (USA)). Jan 1980. Contract EG-77-C-01-4042. 50p. Dep. NTIS, PC A03/MF A01.

The use of thermography to analyze large solar collector array systems under dynamic operating conditions is discussed. The research has focused on thermographic techniques and equipment to determine temperature distributions, flow patterns, and air blockages in solar collectors. The results of this extensive study, covering many sites and types of collectors, illustrate the capabilities of infrared analysis as an analysis tool and operation and maintenance procedure when applied to large arrays. Thermographic analysis of most collector systems showed temperature distributions that indicated balanced flow patterns with both the thermographs and the hand-held unit. In three significant cases, blocked or broken collector arrays, which previously had gone undetected, were discovered. Using this analysis, validation studies of large computer codes could examine collector arrays for flow patterns or blockages that could cause disagreement between actual and predicted performance. Initial operation and balancing of large systems could be accomplished without complicated sensor systems not needed for normal operations. Maintenance personnel could quickly check their systems without climbing onto the roof and without complicated sensor systems.

20440 (SERI/TR—632-439) **Long-term average performance benefits of parabolic trough improvements.** Gee, R.; Gaul, H.W.; Kearney, D.; Rabl, A. (Solar Energy Research Inst., Golden, CO (USA)). Mar 1980. Contract EG-77-C-01-4042. 40p. Dep. NTIS, PC A03/MF A01.

Improved parabolic trough concentrating collectors will result from better design, improved fabrication techniques, and the development and utilization of improved materials. The difficulty of achieving these improvements varies as does their potential for increasing parabolic trough performance. The purpose of this analysis is to quantify the relative merit of various technology advancements in improving the long-term average performance of parabolic trough concentrating collectors. The performance benefits of improvements are determined as a function of operating temperature for north-south, east-west, and polar mounted parabolic troughs. The results are presented graphically to allow a quick determination of the performance merits of particular improvements. Substantial annual energy gains are shown to be attainable. Of the improvements evaluated, the development of stable back-silvered glass reflective surfaces offers the largest performance gain for operating temperatures below 150°C. Above 150°C, the development of trough receivers that can maintain a vacuum is the most significant potential improvement. The reduction of concentrator slope errors also has a substantial performance benefit at high operating temperatures.

20441 (UCRL—83506) **Effect of a heated atmosphere on the emittance of black chrome solar collector pipe surfaces.** Reitter, T.A.; Giedt, W.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 21 Mar 1980. Contract W-7405-ENG-48. 6p. (CONF-800604—6). Dep. NTIS, PC A02/MF A01.

From American section of the International Solar Energy Society conference; Phoenix, AZ, USA (2 Jun 1980).

The total hemispherical emittance of the surfaces of solar collector pipes was measured in the temperature range 100 to 300°C before and after exposure to a heated humid or dry air atmosphere. The first exposure to heated air lowered the emittance of black chrome surfaces about 20%. Similar exposure increased the emittance of bare steel significantly, but had no effort on a nickel surface. Subsequent exposures to heated dry or humid air lowered the emittance of the black chrome surfaces by lesser amounts, in what appeared to be a limiting process. In all cases, the emittance of the black chrome surfaces increased strongly with temperature. A possible explanation for the lowering of the black chrome emittance is the oxidation and subsequent outgassing of carbon contaminants in the black chrome coating. However, sufficient microscopic evidence to verify this hypothesis is not available.

20442 **Device for collecting solor energy with mat of intermingled fibers.** Duchene, G. (to Agence Nationale de Valorisation de la Recherche (ANVAR)). US Patent 4,175,542. 27 Nov 1979. Priority date 30 Jul 1976, France, 12p.

The system comprises a plurality of assembled solar energy collector elements. Cold liquid is supplied at one end and water heated by the solar energy is drawn off at the other end of the device. The liquid circulates through the device in contact with an absorbent mat of intermingled fibres of dark color which is exposed to the solar radiation through at least one translucent sheet which creates a glasshouse effect. The mat guides the flow of liquid by the effect of capillarity and gravity during the heating of the liquid. 19 claims.

20443 (SERI/TP—31-248(Vol.2)(Pt.2), pp 101-131) **Linear concentrating solar collectors: current technology and applications.** Leonard, J.A. (Sandia Labs., Albuquerque, NM). Oct 1979.

From Reliability of materials for solar energy workshop; Denver, CO, USA (18 Dec 1978).

This report surveys linear concentrating collector technology. Included are fundamentals of the technology; descriptions of collectors with particular emphasis on the types tested at the DOE/Sandia Midtemperature Solar Systems Test Facility (MSSTF); performance test results; problems identified through operating experience; cost projections; and a discussion of applications of linear concentrating and midtemperature solar collectors.

20444 (SERI/TP—31-248(Vol.2)(Pt.2), pp 133-136) **Buchmin Industries manufacturers of mirrors and laminated glass.** Jaeger, G.M. (Buchmin Industries, Reedley, CA). Oct 1979.

From Reliability of materials for solar energy workshop; Denver, CO, USA (18 Dec 1978).

20445 (SERI/TP—31-248(Vol.2)(Pt.2), pp 157-164) **Parabolic trough concenrator design for Sandia MSSTF installation.** Oct 1979.

From Reliability of materials for solar energy workshop; Denver, CO, USA (18 Dec 1978).

20446 (SERI/TP—31-248(Vol.2)(Pt.2), pp 167-174) **Reflector materials by vapor deposition techniques.** Bunshah, R.F. (Univ. of California, Los Angeles). Oct 1979.

From Reliability of materials for solar energy workshop; Denver, CO, USA (18 Dec 1978).

20447 (SERI/TP—31-248(Vol.2)(Pt.2), pp 175-192) **Durability of adhesives and sealants.** Harrell, E.R. (Minnesota Mining and Mfg. Co., St. Paul). Oct 1979.

From Reliability of materials for solar energy workshop; Denver, CO, USA (18 Dec 1978).

Many potential designs for parabolic, dish, or heliostat solar concentrators will utilize adhesives or sealants as a part of the design. The major requirements of adhesive/sealant systems will be to maintain the structural integrity of the panels, eliminate unwanted dimensional changes of the reflecting surface, and eliminate any form of attack on the metal vapor coated surface which would reduce or alter it's reflectivity. Factors that affect bondline or sealant joint durability are identified, and pertinent and potentially applicable test methods currently being used are enumerated. In addition, typical properties of specific types of adhesives and sealants, as they might relate to potential uses in the construction of solar concentrators are discussed. (WHK)

20448 (SERI/TP—31-248(Vol.2)(Pt.2), pp 193-206) **Deterioration of silvered glass mirrors for use in solar energy systems.** Roche, S.L. (Sandia Labs., Livermore, CA). Oct 1979.

From Reliability of materials for solar energy workshop; Denver, CO, USA (18 Dec 1978).

20449 (SERI/TP—31-248(Vol.2)(Pt.2), pp 207-233) **Weathering and leaching of glass for solar heliostats.** Rusin, J.M. (Battelle Pacific Northwest Labs., Richland, WA). Oct 1979.

From Reliability of materials for solar energy workshop; Denver, CO, USA (18 Dec 1978).

In order to assess the effects of weathering on the transmittance of glass, several old samples were collected from two desert environments for evaluation. The glass obtained by PNL at the Hanford reservation in Washington came from south-facing, vertical windows which were known to be over forty years old. The glass obtained by Sandia from Barstow, California, is estimated to be over twenty years old (S. Roche, personal communication). The samples all contained areas that were covered from exposure by the window framing material. It was thus possible to compare the exposed and presumably unexposed areas of the glass. To determine the durability of glasses proposed for heliostat mirrors, selected samples were leached in a Soxhlet apparatus and pH 4 and pH 9 buffer solutions. The glass samples produced by the float process are soda-lime-silica glasses, whereas the glass samples produced by the fusion process are aluminosilicate glasses. Results are presented and discussed. (WHK)

20450 (SERI/TP—31-248(Vol.2)(Pt.2), pp 235-250) **Glass durability studies.** Rusin, J.M. (Battelle Pacific Northwest Labs., Richland, WA). Oct 1979.

From Reliability of materials for solar energy workshop; Denver, CO, USA (18 Dec 1978).

20451 (SERI/TP—31-248(Vol.2)(Pt.2), pp 251-265) **Fundamentals of glass weathering problems.** Hench, L.L.; Clark, D.E. (Univ. of Florida, Gainesville). Oct 1979.

From Reliability of materials for solar energy workshop; Denver, CO, USA (18 Dec 1978).

The primary emphasis of this study is on weathering of high durability glass compositions. Some composition-dependent results are presented that should be generally applicable to understanding and preventing deterioration of specialty and historical glasses. The experiments described show that the mechanism of weathering is a near-surface process and is strongly influenced by glass composition, percent relative humidity, temperature, surface treatments, geometric effects such as orientation and distance of separation of glass surfaces, and affinity of the glass surface for water. (WHK)

20452 (SERI/TP—31-248(Vol.2)(Pt.2), pp 617-625) **Corrosion protection monitor for automotive cooling systems and liquid heat transfer systems.** Baboian, R. (Texas Instruments, Attleboro, MA). Oct 1979.

From Reliability of materials for solar energy workshop; Denver, CO, USA (18 Dec 1978).

Corrosion problems in automobile engine cooling systems are well known by the automotive engineer and consumer alike. Both water and antifreeze (ethylene glycol) corrode the engine, radiator, and associated parts. As a result, corrosion inhibitors are added to the antifreeze solution. Unfortunately, the process does not end there, for these inhibitors break down under heat, flow, and pressure. When that happens, the solution begins to attack the engine and radiator, causing pitting, cavitation, and other forms of corrosion even though the antifreeze characteristics are maintained. The problem has been in knowing when the inhibitors break down so that corrective steps can be taken. This brochure describes how a small electronic sensor made by Texas Instruments solves that problem. Although the sensor was developed originally for the automobile, and can now best be explained in terms of an automotive cooling system, it is by no means limited to automobiles. The sensor was designed to detect corrosion in water-based heat transfer fluids that use ethylene glycol or a like chemical along with corrosion inhibitors. Such systems are also used in connection with solar and thermal energy, in machine tools, presses, die-casting machines, and in many other kinds of production and processing equipment.

20453 (SERI/TP—31-248(Vol.2)(Pt.2), pp 627-631) **Single ion property measurements in hot water.** Oct 1979.

From Reliability of materials for solar energy workshop; Denver, CO, USA (18 Dec 1978).

20454 (SERI/TP—31-248(Vol.2)(Pt.2), pp 641-645) **pH monitors for high temperature aqueous solar systems.** MacDonald, D.D.; Scott, A.C.; Wentrcek, P. (SRI International, Menlo Park, CA). Oct 1979.

From Reliability of materials for solar energy workshop; Denver, CO, USA (18 Dec 1978).

HEAT STORAGE

REFER ALSO TO CITATION(S) 20362, 20395, 20396, 20406

20455 (EUR—6646(Pt.1)) **Heat storage in a solar heating system using salt hydrates.** Furbo, S.; Svendsen, S. (Danmarks Tekniske Hoejskole, Lyngby. Thermal Insulation Lab.). Oct 1977. 100p. Dep. NTIS, PC A05/MF A01.

A new method, by means of which a salt water mixture consisting of an incongruently melting salt hydrate with additional water works stably as heat storage material, has been developed. The storage capacity of different promising salt water mixtures has been calculated and measured in a heat storage system using the method where oil was used as the heat transfer fluid. The storage system, which was of the amount of 0.2 m^3 seemed in all ways to work as planned during a few cycles. In order to show that the heat storage system using a salt water mixture as heat storage material will work as planned in a solar heating system during a long period of time, different improvements concerning the performance of the storage system must be carried out. Also a full scale heat storage must be built and tested under realistic conditions during a long period of time.

20456 (ORO—5217-5) **Macro-encapsulation of heat storage phase-change materials for use in residential buildings. Fifth quarterly progress report, September 29, 1977-December 29, 1977.** Lane, G.A.; Warner, G.L.; Hartwick, P.B.; Rossow, H.E. (Dow Chemical Co., Midland, MI (USA)). Mar 1978. Contract EY-76-C-05-5217. 34p. Dep. NTIS, PC A03/MF A01.

Objectives are to assess the feasibility of macro-encapsulated PCM's for residential solar systems, to develop and evaluate such materials. Encapsulant materials under consideration are multilayer flexible plastic films, steel cans, and plastic bottles. PCM's under study are $Mg(NO_3)_2.6H_2O$, stearic acid, $Mg(NO_3)_2.6H_2O$-NH_4NO_3. A study of the storage capability of $CaCl_2.6H_2O$ encapsulated in polyethylene bottles has been completed.

20457 (ORO—5217-7) **Macro-encapsulation of heat storage phase-change materials for use in residential buildings. Seventh quarterly progress report, March 29, 1978-June 29, 1978.** Lane, G.A.; Warner, G.L.; Hartwick, P.B.; Rossow, H.E. (Dow Chemical Co., Midland, MI (USA)). Aug 1978. Contract EY-76-C-05-5217. 25p. Dep. NTIS, PC A02/MF A01.

Objectives are to assess the feasibility of macro-encapsulated PCM's for residential solar systems, to develop and evaluate such materials. Encapsulant materials under consideration are multilayer flexible plastic films, steel cans, and plastic bottles. Studies of the storage capability of $CaCl_2.6H_2O$ encapsulated in polyethylene bottles, $Mg(NO_3)_26H_2O$ in steel cans, and $Mg(NO_3)_26H_2O/NH_4NO_3$ eutectic, encapsulated in flexible plastic film packages, have been completed in the sub-scale storage test unit. The next PCM to be studied is NH_4Br/urea eutectic in polypropylene bottles.

20458 (SAND—79-2056) **Multiple-tank high-temperature storage subsystem. Summary report.** Randall, R.A. (Sandia Labs., Albuquerque, NM (USA)). Feb 1980. Contract EY-76-C-04-0789. 34p. Dep. NTIS, PC A03/MF A01.

The design, construction, installation, and testing of a multiple-tank thermal energy storage subsystem at the Midtemperature Solar Systems Test Facility located in Sandia Laboratories, Albuquerque, New Mexico. Included are the design requirements and a description of the subsystem. Also discussed are the test procedures and test results to evaluate thermal performance. System costs are listed. Subsequent tests are planned to evaluate control techniques and logic.

20459 (SAND—80-8175) **Internally insulated thermal storage system development program. Final report.** (Martin Marietta Aerospace, Denver, CO (USA)). Dec 1979. Contract EY-76-C-04-0789. 172p. (MCR—79-1369). Dep. NTIS, PC A08/MF A01.

The primary objective of this program is to define a cost effective thermal storage system for a solar central receiver power system using molten salt stored in internally insulated carbon steel tanks. This effort was divided into five tasks. The scope of these tasks were: (1) Task 1, internal insulation materials test program: screening tests of candidate insulation materials were conducted by exposing them in 866°K (1100°F) molten salt for 500 hours. Materials selected from these tests were exposed to 866°K salt for up to 5000 hours; (2) Task 2, internally insulated thermocline storage tank analysis: a computer thermal model of internally insulated thermocline tanks was developed to predict thermocline behavior under various operational strategies; (3) Task 3, storage tank design: a preliminary design study and optimization was made of both an externally insulated carbon steel tank for 561°K (550°F) molten salt and an internally/externally insulated carbon steel tank for 839°K (1050°F) molten salt; (4) Task 4, storage system parametric analyses: a computer cost optimization was performed to find the optimum configuration for each of three different storage concepts - thermocline, dual-tank, and cascade systems. The analyses were done as a function of storage size and considered the following factors: tank geometry; number of tanks; insulation type, thickness, and cost; storage use rate; heat loss rate and its impact on upstream costs (heliostats, etc.); and others; (5) Task 5, storage subsystem research experiment (SRE): based on the conclusions of Tasks 1 through 4, a subsystem research experiment was proposed that would demonstrate both fabrication and performance of the major components of the recommended storage design. Results are detailed.

20460 (STU-I—156-1979) **Comparison between the performance of three different methods for storage of low temperature heat (Solarheat) for space heating.** Hedman, H.; Zinko, H.; Nowacki, J.E. (Styrelsen foer Teknisk Utveckling, Stockholm (Sweden)). 1979. 62p. (In Swedish). Dep. NTIS (US Sales Only), PC A04/MF A01.

The following systems were studied: a solar pond with a hot water heating system, airborne heating systems with heat storage in a rock bed or as latent heat in salt hydrates. In the cost estimates, a typical system with 30 m^2 solar collectors and storage need of about 100 kWh was used. The airborne systems were found to be cheaper than the waterborne, and latent heat storage cheaper than rock bed storage.

20461 (SERI/TP—31-248(Vol.2)(Pt.2), pp 267-277) **Low-temperature thermal energy storage program.** Oct 1979.

From Reliability of materials for solar energy workshop; Denver, CO, USA (18 Dec 1978).

20462 (SERI/TP—31-248(Vol.2)(Pt.2), pp 279-294) **Materials problems in reversible chemical reaction storage systems for solar energy.** Mar, R.W. (Sandia Labs., Livermore, CA). Oct 1979.

From Reliability of materials for solar energy workshop; Denver, CO, USA (18 Dec 1978).

Materials problems encountered in the development of thermochemical energy storage systems for solar energy are discussed. Concerns with catalyzed reaction systems include effects of thermal cycling on reactor materials, catalyst availability and lifetime, and undesirable side reactions. Problems have arisen in thermal decomposition systems due to poor or variable kinetics, volume expansion effects, and poor intrinsic heat transfer properties. Reactions which make use of the heat of solution suffer least from materials problems; the major concerns are with the corrosive nature of the chemicals involved (e.g., sulfuric acid, sodium hydroxide).

20463 (SERI/TP—31-248(Vol.2)(Pt.2), pp 295-304) **High temperature thermal energy storage project.** Nice, A.W. Oct 1979.

From Reliability of materials for solar energy workshop; Denver, CO, USA (18 Dec 1978).

20464 (SERI/TP—31-248(Vol.2)(Pt.2), pp 305-312) **Compatibility problems associated with sensible heat storage systems.** Oct 1979.

From Reliability of materials for solar energy workshop; Denver, CO, USA (18 Dec 1978).

20465 (SERI/TP—31-248(Vol.2)(Pt.2), pp 339-359) **High temperature thermal energy storage materials and their properties.** Venkatasetty, H.V. (Honeywell Corporate Material Sciences Center, Bloomington, MN). Oct 1979.

From Reliability of materials for solar energy workshop; Denver, CO, USA (18 Dec 1978).

Data on the heats of fusion and specific heats of promising low-cost eutectic mixtures, with melting points in the range of 465 to 720°C, suitable for thermal energy storage in solar-thermal power program, are presented and compared with the calculated values. It is apparent from the data that lithium salts have the highest energy storage capacity and next in energy storage capacity are the fluoride mixtures of alkali metals and the mixtures of their fluorides and chlorides. Accelerated corrosion studies using electrochemical current-potential curves were made to estimate the corrosion characteristics of the molten salts on ferrous alloys. The corrosion current and corrosion potentials were measured by accentuating the anodic or cathodic process on the alloy specimen. The potentiodynamic polarization curves have been obtained for mild steel, stainless steel and inconel in these molten salt mixtures and the critical current density for passivation measured. The microscopic examination of the surface as well as the lack of hysteresis in the polarization curve on back-scanning the potential seems to show the absence of pitting corrosion. Results are presented. (WHK)

GEOTHERMAL ENERGY

RESOURCE STATUS AND ASSESSMENT

20466 (PNL—3174) **Assessment of geothermal energy as a power source for US aluminum reduction plants.** Enderlin, W.I.; Blahnik, D.E.; Davis, A.E.; Jacobson, J.J.; Schilling, A.H.; Weakley, S.A. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Feb 1980. Contract EY-76-C-06-1830. 125p. Dep. NTIS, PC A06/MF A01.

The technical and economic feasibility of using hydrothermal resources as a primary power source for both existing and future aluminum reduction plants in the United States is explored. Applicable hydrothermal resources that should be considered by the aluminum industry for this purpose were identified and evaluated. This work also identified the major institutional parameters to be considered in developing geothermal energy resources for aluminum industry use. Based on the findings of this study, it appears technically and economically feasible to power existing aluminum reduction plants in the Pacific Northwest using electricity generated at Roosevelt Hot Springs, Utah. It may also be feasible to power existing plants located on the Gulf Coast from Roosevelt Hot Springs, depending on the cost of transmitting the power.

USA

REFER ALSO TO CITATION(S) 20470, 20479

GEOLOGY, HYDROLOGY, AND GEOTHERMAL SYSTEMS

USA

20467 (DOE/ET/28392—27(5-79)) **Geology of the Cove Fort-Sulphurdale KGRA.** Moore, J.N.; Samberg, S.M. (Utah Univ., Salt Lake City (USA). Research Inst.). May 1979. Contract EG-78-C-07-1701. 110p. Dep. NTIS, PC A06/MF A01.

The Cove Fort-Sulphurdale Known Geothermal Resource Area (KGRA) is located on the northwestern margin of the Marysvale volcanic field in southwestern Utah. The geology of the KGRA is dominated by lava flows and ash-flow tuffs of late Oligocene to mid-Miocene age that were deposited on faulted sedimentary rocks of Paleozoic to Mesozoic age. The geothermal system of the Cove Fort-Sulphurdale KGRA is structurally controlled by normal faults. High-angle faults control fluid flow within the geothermal reservoir, while the gravitational glide blocks provide an impermeable cap for the geothermal system in the central part of the field. Surficial activity occurring to the north and south of the glide blocks is characterized by the evolution of hydrogen sulfide and deposition of native sulphur. Intense acid alteration of the aluvium, resulting from downward migration of sulphuric acid, has left porous siliceous residues that retain many of the original sedimentary structures. Detailed logs of Union Oil Company drill holes Forminco No. 1, Utah State 42-7, and Utah State 31-33 are included.

20468 **Geochemistry of hydrothermal alteration at the Roosevelt Hot Springs thermal area, Utah.** Parry, W.T.; Ballantyne, J.M.; Bryant, N.L.; Dedolph, R.E. (Univ. of Utah, Salt Lake City). *Geochim. Cosmochim. Acta;* **44**: No. 1, 95-102(Jan 1980).

Hot spring deposits in the Roosevelt thermal area consist of opaline sinter and sinter-cemented alluvium. Alluvium, plutonic rocks, and amphibolite-facies gneiss have been altered by acid-sulfate water to alunite and opal at the surface, and alunite, kaolinite, montmorillonite, and muscovite to a depth of 70 m. Marcasite, pyrite, chlorite, and calcite occur below the water table at about 30 m. The thermal water is dilute (ionic strength 0.1 to 0.2) sodium-chloride brine. The spring water now contains 10 times as much Ca, 100 times as much Mg, and up to 2.5 times as much SO_4 as the deep water. Although the present day spring temperature is 25°C, the temperature was 85°C in 1950. A model for development of the observed alteration is supported by observation and irreversible mass transfer calculations. Hydrothermal fluid convectively rises along

major fractures. Water cools by conduction and steam separation, and the pH rises due to carbon dioxide escape. At the surface, hydrogen and sulfate ions are produced by oxidation of H_2S. The low pH water percolates downward and reacts with feldspar in the rocks to produce alunite, kaolinite, montmorillonite, and muscovite as hydrogen ion is consumed. 4 figures, 4 tables.

GEOTHERMAL EXPLORATION AND EXPLORATION TECHNOLOGY

20469 (DOE/DP/01540—3) **Status of Pilgrim springs.** Kirkwood, P. (Energy Systems, Inc., Anchorage, AK (USA)). May 1979. Contract EY-76-C-08-1540. 45p. Dep. NTIS, PC A03/MF A01.

Information on the resource includes the following: historical background, geological reconnaissance, resistivity, seismic refraction, magnetic profiling, microseismic background, temperature measurement, and chemical analysis. A planned geothermal exploration and an agricultural demonstration program are described. (MHR)

20470 (DOE/ID/01713—4) **Hawaii Geothermal Resource Assessment Program: western state cooperative direct heat resource assessment, Phase I. Final report.** (Hawaii Univ., Honolulu (USA). Hawaii Inst. of Geophysics). 1978. Contract AS07-78ID01713. 190p. Dep. NTIS, PC A09/MF A01.

A regional geothermal resource assessment has been conducted for the major islands in the Hawaiian chain. The assessment was made through the compilation and evaluation of the readily accessible geological, geochemical, and geophysical data for the Hawaiian archipelago which has been acquired during the last two decades. The geologic criteria used in the identification of possible geothermal reservoirs were: age and location of most recent volcanism on the island and the geologic structure of each island. The geochemical anomalies used as traces for geothermally altered ground water were: elevated silica concentrations and elevated chloride/magnesium ion ratios. Geophysical data used to identify subsurface structure which may have geothermal potential were: aeromagnetic anomalies, gravity anomalies, and higher than normal well and basal spring discharge temperatures. Geophysical and geochemical anomalies which may be the result of subsurface thermal effects have been identified on the islands of Hawaii, Maui, Molokai and Oahu.

GEOPHYSICAL TECHNIQUES AND SURVEYS

REFER ALSO TO CITATION(S) 20473, 21549

20471 (DOE/ET/28392—37) **Numerical modeling and interpretation of dipole-dipole resistivity and IP profiles Cove Fort-Sulphurdale KGRA, Utah.** Ross, H.P. (Utah Univ., Salt Lake City (USA). Research Inst.). Dec 1979. Contract EG-78-C-07-1701. 81p. Dep. NTIS, PC A05/MF A01.

The Cove Fort-Sulphurdale Known Geothermal Resource Area (KGRA) is located near the junction of the Pavant Range and the Tushar Mountains in south-central Utah. The area has been the site of an intensive geothermal exploration effort since 1975. The electrical resistivity data obtained by Union Oil Company and a subsequent survey conducted for the Earth Science Laboratory and a detailed numerical interpretation of both data sets are presented. The detailed modeling permits a characterization of the intrinsic electrical resistivity to depths exceeding 2000 feet. An area of over two square miles with bulk in-situ resistivities of four-to-five ohm-m is delineated at Sulphurdale near the Union Oil Co. well CFSU No. 42-7. The low-resistivities rocks define the area of extensive hydrothermal alteration in response to the presence of clay minerals and conductive thermal fluids. In contrast the area north and east of Cove Fort is typified by high (100-300 ohm-m) resistivities to depths exceeding 2000 feet. This is an area of Cretaceous and Paleozoic sedimentary rocks where two attempts to drill to reservoir depth failed because of extreme drilling problems. The high resistivities are not considered encouraging for the presence of a deeper reservoir. The electrical resistivity interpretation has defined several areas of probable upward migration of thermal fluids along north-trending normal faults. Some of these areas may have potential for direct heat geothermal utilization.

20472 **Seismic array noise studies at Roosevelt Hot Springs, Utah geothermal area.** Douze, E.J.; Laster, S.J. (Univ. of Tulsa, OK). *Geophysics;* **44**: No. 9, 15-70(Sep 1979).

As part of a study of a geothermal steam field at Roosevelt Hot Springs in Utah, the background seismic noise was investigated using seismometer arrays. Roosevelt Hot Springs is located on the Wasatch front in southern Utah, an area characterized by Tertiary intrusions. Arrays of vertical seismometers with spacings of 50 to 100 m were installed at selected locations. The data from three arrays were studied in detail; one was located directly above the geothermal reservoir, one was in the valley to the west, and one was in the Mineral Mountains to the east of the reservoir. The principle analysis technique consisted of computing frequency-wavenumber spectra of the noise in the frequency range from 0.5 to 10 Hz. For frequencies less than 1.0 Hz, the arrays were too small for adequate resolution, and at frequencies higher than 10.0 Hz, the noise showed no spatial organization. The theoretical response of seismometer arrays to waves arriving from numerous directions, such as would be the case directly above a geothermal reservoir, is developed to allow comparison with the experimental results. During times of cultural activity (mainly road traffic and trains in the valley), the noise was highly variable in amplitude and consisted almost exclusively of Rayleigh waves from the cultural sources. At quiet times, the noise field was more complex. For the arrays at the reservoir and in the valley, the results of frequency-wavenumber computations indicate that the noise consists of isotropic Rayleigh waves. No waves were detected that could be related to the geothermal reservoir. The array in the Mineral Mountains, farther away from the cultural noise sources, showed a completely different noise field. The noise consisted of high-velocity P-waves from a source to the east of the known geothermal area.

EXPLORATORY DRILLING AND WELL LOGGING

20473 (COO—4715-1) **Preliminary targeting of geothermal resources in Delaware. Progress report, July 15, 1978-July 14, 1979.** Woodruff, K.D. (Delaware Geological Survey, Newark (USA)). Jul 1979. Contract ET-78-S-02-4715. 36p. Dep. NTIS, PC A03/MF A01.

Results of temperature logging the five DOE 1000 foot test wells in Delaware indicate that the potential is good for a relatively low temperature geothermal resource (temperatures less than about 80°C). A preliminary Bouguer gravity map was made for portions of Kent and Sussex counties in order to detect gravity anomalies possibly related to granitic plutons. The map indicates a gravity low trending northeast-southwest across Sussex County that could be indicative of other structural features within the basement rocks beneath the Coastal Plain. Other logging activities and study of the cores and drill cuttings in the DOE test holes were useful in better defining the stratigraphic framework and in determining the fresh-salt water interface in southern Delaware.

20474 (SAND—78-2288) **Magma energy research project: state-of-the-project report, October 1, 1978.** Colp, J.L.; Traeger, R.K. (Sandia Labs., Albuquerque, NM (USA)). Feb 1980. Contract EY-76-C-04-0789. 159p. Dep. NTIS, PC A08/MF A01.

The feasibility of extracting energy from magma bodies is investigated. The work done in FY 76, 77, and 78 in the following tasks are summarized; resource location and definition, source tapping, magma characterization and materials compatibility, and energy extraction. (MHR)

20475 (SAND—80-0046) **Upgrading Amerada-type survey clocks for high-temperature geothermal service.** Major, B.H.; Witten, C.L. (Sandia Labs., Albuquerque, NM (USA)). Apr 1980. Contract EY-76-C-04-0789. 20p. Dep. NTIS, PC A03/MF A01.

The Amerada type subsurface recording gauges have been used by the oil and gas industry for many years. These mechanical logging instruments are currently used by the growing geothermal industry. As the gauges were designed for service in low-temperature oil and gas wells, a significant number of failures are occurring at elevated geothermal temperatures. The spring-driven mechanical survey clocks appear to be the primary cause of these failures. The clock mechanisms tend to stop or lock-up when exposed to temperatures as high as 300°C. A project that was undertaken to upgrade the survey clocks to 300°C capability is summarized. The major problems causing clock failure were determined and were rectified by minor modifications and lubrication of the moving parts. Several clocks so modified performed reliably, both during laboratory oven tests and during field tests performed in actual geothermal wells at temperatures up to 330°C.

LEGAL AND INSTITUTIONAL ASPECTS

REFER ALSO TO CITATION(S) 20495

20476 (SAN—2121-5) **Geothermal development and land use/energy planning by the State of California and its political subdivisions.** (JM Energy Consultants, Inc., Los Angeles, CA (USA)). 30 Jul 1978. Contract ET-78-C-03-2121. 61p. Dep. NTIS, PC A04/MF A01.

California law contains several vehicles for the implementation of geothermal planning. These mechanisms and their impact are examined. First, at the State level upon the California Energy Commission and the Division of Oil and Gas in the Department of Conservation. After some background on county planning in California, the unique situation in the counties of greatest geothermal potential is presented: Imperial County and the four Geysers coun-

ties as well as their joint powers agency. Conclusions and recommendations are included. (MHR)

ECONOMIC AND FINANCIAL ASPECTS

20477 (DOE/ID/12010—2) **Idaho Geothermal Commercialization Program. Idaho geothermal handbook.** Hammer, G.D.; Esposito, L.; Montgomery, M. (Department of Energy, Idaho Falls, ID (USA). Idaho Operations Office). Mar 1980. Contract FC07-79ID12010. 89p. Dep. NTIS, PC A05/MF A01.

The following topics are covered: geothermal resources in Idaho, market assessment, community needs assessment, geothermal leasing procedures for private lands, Idaho state geothermal leasing procedures - state lands, federal geothermal leasing procedures - federal lands, environmental and regulatory processes, local government regulations, geothermal exploration, geothermal drilling, government funding, private funding, state and federal government assistance programs, and geothermal legislation. (MHR)

ENVIRONMENTAL ASPECTS AND WASTE DISPOSAL

20478 (DOE/ER/10092—T7) **Analysis of hypochlorite process for removal of hydrogen sulfide from geothermal gases.** (Sheinbaum (I.) Co., Inc., Pasadena, CA (USA)). Apr 1980. Contract AC05-79ER10092. 35p. Dep. NTIS, PC A03/MF A01.

Sodium hypochlorite reacts readily with hydrogen sulfide to convert the sulfide ion into free sulfur in a neutral or acid solution and to the sulfate ion in an alkaline solution. Sodium hypochlorite can be generated on site by processing geothermal brine in electrolytic cells. An investigation to determine if this reaction could be economically used to remove hydrogen sulfide from geothermal noncondensible gases is reported. Two processes, the LO-CAT Process and the Stretford Process, were selected for comparison with the hypochlorite process. Three geothermal reservoirs were considered for evaluation: Niland KGRA, Baca KGRA, and The Geysers KGRA. Because of the wide variation in the amount of hydrogen sulfide present at The Geysers, two different gas analyses were considered for treatment. Plants were designed to process the effluent noncondensible gases from a 10 MW/sub e/ geothermal power plant. The effluent gas from each plant was to contain a maximum hydrogen sulfide concentration of 35 ppb. Capital costs were estimated for each of the processes at each of the four sites selected. Operating costs were also calculated for each of the processes at each of the sites. The results of these studies are shown.

20479 (FWS/OBS—76/60) **Ecological implications of geopressurized-geothermal energy development: Texas-Louisiana Gulf Coast Region.** Gustavson, T.C.; McGraw, M.M.; Tandy, M.; Parker, F.; Wohlschlag, D.E. (Texas Univ., Austin (USA). Bureau of Economic Geology; Texas Univ., Port Aransas (USA). Marine Science Inst.). Mar 1978. 670p. Fish and Wildlife Service, Fort Collins, CO.

Two papers are included. Separate abstracts were prepared for each. The following are included in appendices. A number of research needs related to the problems addressed here have been summarized. An extensive reference section was compiled and includes an annotated bibliography indexed by subject matter. Lists of research scientists and/or institutions with expertise on the Texas-Louisiana coastal zone and/or geothermal energy are included. (MHR)

20480 (FWS/OBS—7860, pp 64-113) **Alternative use of waste geothermal heat.** Aug 1977.

In Ecological implications of geopressured-geothermal energy development Texas-Louisiana Gulf Coast Region.

The ecological resource and potential environmental impacts are described. A review of available information on fish and wildlife resources in areas proposed for geothermal exploitation is presented. Physical and biological resources are summarized. Features that may be influenced or affected by geopressured energy activities are highlighted. Potential environmental impacts arising from the exploitation of geothermal energy on the Gulf Coast will vary with the location of the site, with the scale of industrial operations, with the type of generating and disposal systems employed, and with various management practices. Processes and fluctuations among physical, chemical, and biological ecosystem components are emphasized in order to provide a baseline enabling identification of critical requirements for maintaining ecosystem productivity and integrity. Evaluation of potential environmental impacts relating to this resource is based on technical information presented in Phase I of this project.

20481 (ORO—5862-7(Vol.1)) **Preliminary environmental assessment of selected geopressured - geothermal prospect areas: Louisiana Gulf coast region. Volume I. Comparison of prospect areas on the basis of potential environmental impacts.** Newchurch, E.J.; Bachman, A.L.; Bryan, C.F.; Harrison, D.P.; Muller, R.A.; Newman, J.P. Jr.; Smith, C.G. Jr.; Bailey, J.I. Jr.; Kelly, G.G.; Reibert, K.C. (Louisiana State Univ., Baton Rouge (USA). Inst. for Environmental Studies). 15 Oct 1978. Contract ET-78-S-05-5862. 150p. Dep. NTIS, PC A07/MF A01.

The results of a preliminary environmental assessment of the following geopressured-geothermal prospect areas in the Louisiana Gulf coast region are presented: South Johnson's Bayou, Sweet Lake, Rockefeller Refuge, Southeast Pecan Island, Atchafalaya Bay, and Lafourche Crossing. These prospect areas have been compared to determine their relative environmental acceptability for the test program. Trade-offs among the prospects in terms of potential impacts are highlighted. This assessment was made on the basis of the nature and extent of the proposed testing activities in view of the environmental characteristics of each prospect area: land use, geology and geohydrology, air quality, water resources and quality, ecological systems, and natural hazards. The comparison of prospect areas includes consideration of worst case situations. However, we believe that the test program activities, because they are so small in scale, will not result in major adverse impacts.

20482 (ORO—5862-7(Vol.2)) **Preliminary environmental assessment of selected geopressured - geothermal prospect areas: Louisiana Gulf Coast Region. Volume II. Environmental baseline data.** Newchurch, E.J.; Bachman, A.L.; Bryan, C.F.; Harrison, D.P.; Muller, R.A.; Newman, J.P. Jr.; Smith, C.G. Jr.; Bailey, J.I. Jr.; Kelly, G.G.; Reibert, K.C. (Louisiana State Univ., Baton Rouge (USA). Inst. for Environmental Studies). 15 Oct 1978. Contract ET-78-S-05-5862. 648p. Dep. NTIS, PC A99/MF A01.

A separate section is presented for each of the six prospect areas studied. Each section includes a compilation and discussion of environmental baseline data derived from existing sources. The data are arranged as follows: geology and geohydrology, air quality, water resources and flood hazards, ecological systems, and land use. When data specific to the prospect were not available, regional data are reported. (MHR)

20483 (UCRL—15206) **Quality control and assurance applied to the analysis of environmental samples collected from known geothermal sites. Final report.** Cooper, J.A. (Oregon Graduate Center, Beaverton (USA)). 31 Jan 1978. Contract W-7405-ENG-48. 16p. Dep. NTIS, PC A02/MF A01.

The components of an analytical quality control and assurance program for the analysis of trace toxic and priority pollutants are reviewed in general. It is recommended that these principles be applied to develop increased confidence in a laboratory's analytical accuracy by establishing validated standard operating procedures with built in controls and internal cross checks and developing an approved standard operating procedure for quality assurance consisting of audits and appropriate documentation. It is recommended that interlaboratory comparisons be considered as a means of continually documenting analytical accuracy.

20484 (UCRL—52887) **Workshop on environmental control technology for The Geysers-Calistoga KGRA.** Hill, J.H.; Phelps, P.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 Jan 1980. Contract W-7405-ENG-48. 54p. (CONF-7810229—). Dep. NTIS, PC A04/MF A01.

From Workshop on environmental control technology for the Geysers-Calistoga KGRA; Oakland, CA, USA (11 Oct 1978).

The proceedings of six work groups that discussed techniques to prevent and abate noise, hydrogen sulfide emissions, and accidental spills of chemicals and geothermal wastes at The Geysers-Calistoga KGRA are reported. Problems associated with well completion and production, and with systems, components, and materials, and their effects on emissions were also discussed. The comments and recommendations of the work groups are included in the proceedings. (MHR)

20485 (UCRL—83681) **Geothermal power production: impact assessments and environmental monitoring.** Layton, D.W.; Pimentel, K.D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jan 1980. Contract W-7405-ENG-48. 7p. (CONF-800517—1). Dep. NTIS, PC A02/MF A01.

From 26. annual technical meeting of the Institute for Environmental Sciences; Philadelphia, PA, USA (11 May 1980).

The role that baseline and postoperational environmental monitoring plays in assessing impacts of geothermal power production is emphasized. Based on experience in the Imperial Valley, where substantial geothermal resources exist, the important characteristics of monitoring programs involving subsidence, seismicity, and air and water quality are examined. The importance of environmental monitoring for situations where predictive models either do not exist (e.g., seismicity), or are still being developed (e.g., land subsidence) are discussed. In these cases the need for acquiring and analyzing data that can provide timely information on changes caused by geothermal operations are emphasized. Monitoring is also useful in verifying predictions of air quality changes - in particular, violations of ambient standards after control technologies are imple-

mented. Water quality can be monitored with existing sampling programs where the potential for geothermal impacts is thought to be rather small. The significant issues in these environmental areas, the status of baseline data and predictive capability that currently exists, and the need for future monitoring and modeling programs to assess the impacts of geothermal development are summarized.

GEOTHERMAL POWER PLANTS

REFER ALSO TO CITATION(S) 20466, 20525, 20526, 20527, 20528

20486 (LA-UR—80-731) **Development of hot dry rock geothermal resources; technical and economic issues.** Tester, J.W. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 37p. (CONF-800135—1). Dep. NTIS, PC A03/MF A01.

From Rubey colloquium; Los Angeles, CA, USA (28 Jan 1980).

Technical and economic issues related to the commercial feasibility of hot dry rock geothermal energy for producing electricity and heat are discussed. Topics covered include resource characteristics, reservoir thermal capacity and lifetime, drilling and surface plant costs, financial risk and anticipated rate of return. The current status of research and deveopment efforts in the US are also summarized.

POWER PLANT SYSTEMS AND COMPONENTS

20487 (EGG—2010) **Semiannual progress report for the Idaho Geothermal Program, April 1-September 30, 1979.** Ihrig, R.R. (Idaho National Engineering Lab., Idaho Falls (USA)). Mar 1980. Contract EY-76-C-07-1570. 55p. Dep. NTIS, PC A04/MF A01.

Progress made by the Idaho Geothermal Program between March 31 and September 30, 1979 is discussed. Geothermal well tests at the Raft River geothermal site, facility construction, and the first hydraulic fracture treatment of a geothermal well are summarized. The results of direct applications experiments are described briefly, including experiments in aquaculture, agriculture, fluidized bed space heating, fluidized bed food drying, essential oil extraction, and geothermal assisted conversion of biomass to ethanol. Improvements to the binary cycle prototype power plant at Raft River, construction progress on the 5-MW pilot plant, and experimental work on direct contact heat exchangers are discussed. Also outlined is progress on environmental studies at Raft River, including a brief discussion of socioeconomic impacts of geothermal development on Cassia County, Idaho. Results are presented of a 48-industry survey conducted to determine industry's views of the technology barriers to accelerating hydrothermal energy commercialization. A projection summarizes the capital and manpower needed through 1987 to place 6800 MW of direct applications development online. Progress reports are also included on DOE's Program Opportunity Notice (PON) Program demonstration projects and DOE's Program Research and Development Announcement (PRDA) Program study projects.

20488 (LBL—10442) **Heat transfer to isobutane flowing inside a horizontal tube at supercritical pressure.** Hsu, I.C.W. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1979. Contract W-7405-ENG-48. 228p. Dep. NTIS, PC A11/MF A01.

Thesis.

An experimental measurements of heat transfer coefficient of isobutane at 4.14 MPa (600 psia) has been performed using the experimental system developed by the Sea Water Conversion Laboratory. The experimental system simulates a geothermal power plant utilizing a binary cycle with isobutane as the working fluid. In this system, isobutane is heated inside a horizontal tube with steam condensing on the outside.

GEOTHERMAL ENGINEERING

DRILLING TECHNOLOGY AND WELL HARDWARE

20489 (SAND—79-7120) **Workshop on geothermal drilling fluids, Houston, Texas, 23 May 1978.** (Maurer Engineering, Inc., Houston, TX (USA)). Mar 1980. Contract EY-76-C-04-0789. 55p. Dep. NTIS, PC A04/MF A01.

Eight papers are included. Separate abstracts were prepared for each. (MHR)

20490 (SAND—79-7120, pp 9-16) **Geothermal well technology program.** Varnado, S.G. (Sandia Labs., Albuquerque, NM). Mar 1980.

In Workshop on geothermal drilling fluids, Houston, Texas, 23 May 1978.

The high cost of drilling and completing geothermal wells is an impediment to the development of geothermal energy resources. Technological deficiencies in rotary drilling techniques are evidenced when drilling geothermal wells. A program aimed at developing new drilling and completion techniques for geothermal wells was initiated. The goals of this program are to reduce well costs by 25% by 1982 and by 50% by 1986. An overview of the program is presented. Program justification which relates well cost to busbar energy cost and to DGE power-on-line goals is presented. Technological deficiencies encountered when current rotary drilling techniques are used for geothermal wells are discussed. A program for correcting these deficiencies is described.

20491 (SAND—79-7120, pp 17-22) **Application and utilization of improved geothermal drilling fluid technology.** Remont, L.J. Mar 1980.

In Workshop on geothermal drilling fluids, Houston, Texas, 23 May 1978.

The best high temperature drilling fluids that could be formulated from commercially available materials from five of the largest mud companies were evaluated. An improved geothermal mud was developed for drilling into hydrothermal reservoirs. Its composition is given and its properties are discussed. (MHR)

20492 (SAND—79-7120, pp 23-26) **Evaluation of drilling foams.** Remont, L.J.; McDonald, W.J. Mar 1980.

In Workshop on geothermal drilling fluids, Houston, Texas, 23 May 1978.

A study initiated to determine the applicability of foams in geothermal drilling, to test some of these foams, and to recommend a foam development program is described briefly. (MHR)

20493 (SAND—79-7120, pp 27-32) **Development of a laboratory instrument to measure properties of drilling fluids under extreme geothermal conditions.** Reid, K.I.G.; Murphy, R.J.; Walter, K.L. (NL Industries, Inc., Houston, TX). Mar 1980.

In Workshop on geothermal drilling fluids, Houston, Texas, 23 May 1978.

The basic purpose of the Geothermal Drilling Fluid Testing System is to allow measurement of fluid porperties ranging up to 700°F and 20,000 psi. Major fluid properties to be measured are rheology, filtration characteristics, density, and corrosivity. A block diagram of system components, the autoclave, and a conceptual design for the continuous dynamic filter as shown. (MHR)

20494 (SAND—79-7120, pp 33-47) **Portable high temperature, high pressure viscometer.** Reineke, R.C.; Varnado, S.G. (Sandia Labs., Albuquerque, NM). Mar 1980.

In Workshop on geothermal drilling fluids, Houston, Texas, 23 May 1978.

A field instrument for measuring the rheological characteristics of drilling mud at simulated downhole conditions has been developed. The instrument can provide viscosity measurement to 300 centipoise at temperatures up to 500°F, pressures up to 12,500 psi, and shear rates up to 1000 sec^{-1}. The design of the system and the results of some preliminary tests on water-based and oil-based drilling muds are described. The design consists of a rotational viscometer packaged inside a heated pressure vessel. The fluid sample is placed inside a test cell and the desired temperatures and pressure conditions are then selected. A direct readout of viscosity is provided. Four samples of water-based muds have been tested; a bentonite mud, a bentonite mud with FCL thinner, a bentonite based mud with FCL and lignite thinners, and a mud developed by Maurer Engineering for geothermal use. Tests on these muds indicate that the addition of thinners is effective in increasing the usable temperature range of the bentonite mud from approximately 125°C to 200°C. Pressure effects on water-based muds were found to be insignificant. Oil-based muds exhibited thinning characteristics with increasing temperature and a marked increase in viscosity with increased pressure. Therefore, during drilling, the borehole pressure tends to compensate for the thinning effect of borehole temperature. Curves showing this quantitative dependence of viscosity on temperature and pressure are presented.

20495 (SAND—79-7120, pp 49-52) **Governmental regulations and geothermal drilling fluids.** Primm, L.A. Mar 1980.

In Workshop on geothermal drilling fluids, Houston, Texas, 23 May 1978.

Regulations which relate to drilling fluids in the Geothermal Resources Operational Orders under the Geothermal Steam Act of 1970 are excerpted. The three aspects of a geothermal well concerned in the regulations are well control, environmental protection, and resource protection. (MHR)

20496 (SAND—79-7120, pp 53-57) **Drilling fluid formation damage in geothermal wells.** Nicholson, R.W. Mar 1980.

In Workshop on geothermal drilling fluids, Houston, Texas, 23 May 1978.

The basic factors unique to matrix type hot-water reservoirs which make them susceptible to drilling fluid damage are listed.

General steps to be taken to reduce formation damage are reviewed. (MHR)

CORROSION, SCALING, AND MATERIALS DEVELOPMENT

20497 (UCRL—52897) **Studies of the dissolution of geothermal scale.** Deutscher, S.B.; Ross, D.M.; Quong, R.; Harrar, J.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 Feb 1980. Contract W-7405-ENG-48. 25p. Dep. NTIS, PC A02/MF A01.

Samples of geothermal scale formed from Magmamax No. 1 and Woolsey No. 1 wells in the Imperial Valley, Calif., were exposed to concentrated and dilute solutions of common laboratory reagents. The time of exposure and temperature of the reagent were also varied. Several reagents easily dissolved significant amounts of the scale. An in situ test was performed with marginal success.

GEOTHERMAL RESERVOIR AND WELL PERFORMANCE

20498 (LBL—9326(Rev.)) **Status of Geothermal Reservoir Engineering Management Program (GREMP).** Howard, J.H.; Schwarz, W.J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1979. Contract W-7405-ENG-48. 7p. Dep. NTIS, PC A02/MF A01.

In the fall of 1976, the US Department of Energy (DOE), Division of Geothermal Energy (DGE) proposed that Lawrence Berkeley Laboratory (LBL) assume lead responsibility, on DGE's behalf, for the management of a program of support of research related to geothermal reservoir engineering. Since its inception, this activity, known as GREMP has included 18 separate contracts on a variety of technical and scientific projects. Altogether, 23 distinguishable research topics have been addressed. Fourteen institutions, including eight private companies, have contracted with the program. The status of the work as of December, 1979 is summarized. All high priority elements of the original program that were assigned to LBL for implementation have been addressed except for investigations of properties of materials. In the future the program should emphasize this neglected element as well as assure meaningful evaluation, preferably in the field, of the applicability of research supported to date.

RESERVOIR STIMULATION AND EXTRACTION TECHNOLOGY

20499 (LA-UR—80-912) **Hot dry rock geothermal reservoir engineering.** Aamodt, R.L. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 5p. (CONF-800344—1). Dep. NTIS, PC A02/MF A01.

From 3. invitational well testing symposium; Oakland, CA, USA (26 Mar 1980).

Two wells, GT-2 and EE-1, were originally drilled to a depth of 9600 ft (2.93 km) and 10,000 ft (3.05 km), respectively, and, after some difficulties, including redrilling of the bottom portion of GT-2, a good fracture connection was made between EE-1 and GT-2B, as the modified GT-2 was called. The circulation system was studied extensively for the purpose of establishing a number of fracture properties. Techniques were developed to determine orientation, geometry, heat exchange area, volume, flow impedance and impedance distribution. A much larger fracture system was then created from a depth of 9620 ft (2.93 km) in EE-1. The techniques used and results obtained in the study of the new and old fracture systems are discussed. (MHR)

20500 (SAND—80-0309) **Magma energy: a feasible alternative.** Colp, J.L. (Sandia Labs., Albuquerque, NM (USA)). Mar 1980. Contract EY-76-C-04-0789. 22p. Dep. NTIS, PC A02/MF A01.

A short review of the work performed by Sandia Laboratories in connection with its Magma Energy Research Project is provided. Results to date suggest that boreholes will remain stable down to magma depths and engineering materials can survive the downhole environments. Energy extraction rates are encouraging. Geophysical sensing systems and interpretation methods require improvement, however, to clearly define a buried magma source.

DIRECT ENERGY UTILIZATION

REFER ALSO TO CITATION(S) 20469, 20486, 20487

20501 (EGG—2013) **Geothermal direct applications hardware systems development and testing. 1979 summary report.** Keller, J.G. (Idaho National Engineering Lab., Idaho Falls (USA)). Mar 1980. Contract EY-76-C-07-1570. 43p. Dep. NTIS, PC A03/MF A01.

Activities performed during calendar year 1979 for the hardware system development and testing task are presented. The fluidized bed technology was applied to the drying of potato byproducts and to the exchange of heat to air in the space heating experiment. Geothermal water was flashed to steam and also used as the prime energy source in the steam distillation of peppermint oil. Geothermal water temperatures as low as 112.8°C were utilized to distill alcohol from sugar beet juice, and lower temperature water provided air conditioning through an absorption air conditioning system. These experiments are discussed.

GEOTHERMAL DATA AND THEORY

PROPERTIES OF MINERALS AND ROCKS

20502 (LA-UR—80-827) **Influence of orientation on fracture toughness and tensile moduli in Berkeley granite.** Halleck, P.M.; Kumnick, A.J. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 9p. (CONF-800507—3). Dep. NTIS, PC A02/MF A01.

From Rock mechanics symposium; Rolla, MO, USA (27 May 1980).

Fracture toughness and tensile modulus values for Berkeley granite show pronounced orientation dependence. Apparent fracture toughness values (K/sub Q/) correspond to natural strong and weak planes in the rock: cracks propagated in the head grain (strongest) plane have K/sub Q/ = 1.81 MPa $\sqrt{m}$, those grown in the rift (weakest) plane have K/sub Q/ = 1.01 MPa $\sqrt{m}$ and those in the grain (intermediate) plane have K/sub Q/ = 1.40 MPa $\sqrt{m}$. These directional K/sub Q/ data also correlate with tensile modulus values, E, which are 50.7 GPa,, 21.6 GPa and 39.3 GPa, respectively. An empirical relationship between K/sub Q/ and E is demonstrated. Monitoring of acoustic emission events shows promise as a detector of onset of crack growth.

WIND ENERGY

AVAILABILITY (CLIMATOLOGY)

REFER ALSO TO CITATION(S) 20522

20503 (RLO—2227-79/3) **Handbook on the use of trees as an indicator of wind power potential. Final report.** Hewson, E.W.; Wade, J.E.; Baker, R.W. (Oregon State Univ., Corvallis (USA). Dept. of Atmospheric Science). Jun 1979. Contract EY-76-S-06-2227-024. 27p. Dep. NTIS, PC A03/MF A01.

High wind areas are conveniently located using a procedure known as Biological Wind Prospecting. This handbook describes such techniques for using trees as indicators of wind power potential and is aimed at providing the wind prospector with an initial assessment of the wind power potential. Subsequent sections will describe these techniques for using trees in a wind survey, the role of vegetation indicators in site selection and the limitations of these techniques.

ECONOMICS

REFER ALSO TO CITATION(S) 20268

WIND ENERGY ENGINEERING

REFER ALSO TO CITATION(S) 20341

20504 (SERI/TP—351-431, pp 229-232) **Output power of wind machines.** Powell, W.R. (Applied Physics Lab., Laurel, MD). 1980.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

A new model of wind machine output power is suggested. This model not only avoids errors associated with prior models, but also allows the average power produced by a wind machine to be calculated without resort to numerical methods. The average power is expressed as a function of the cut-in, rated and maximum speeds of the wind machine and the two parameters used to characterize wind speeds with Weibull statistics. The variation of average power and capacity factos with changes in wind-machine design is explored. These analytical results provide a useful guide for machine selection prior to more detailed analysis. An application for wind power is suggested.

TURBINE DESIGN AND OPERATION

20505 (ALO—4272-T2) **Design and fabrication of a low cost Darrieus vertical axis wing turbine system. Phase I. Technical report.**

(Aluminum Co. of America, New Kensington, PA. Aluminum Research Labs.). 22 Jun 1979. Contract EM-78-C-04-4272. 345p. Dep. NTIS, PC A15/MF A01.

The contract has two phases, a design phase and a fabrication and installation phase. Presented is the work completed in Phase I, the design phase. The Sandia 17 m was used as the background machine from which design information was drawn. By concentrating the modifications on an existing design, emphasis was focused on component cost reduction rather than selection of optimal configuration or operating modes. The resulting design is a stretched version of the Sandia 17 m preserving the same rotor diameter and many other good features, but in the meantime lighter in weight, larger in capacity, and anticipated to be more cost effective.

20506 (COO—4131-T1(Vol.1)) **Methods for design analysis of horizontal axis wind turbines. Wind energy conversion.** Miller, R.H.; Dugundji, J.; Martinez-Sanchez, M.; Gohard, J.; Chung, S.; Wendell, J. (Massachusetts Inst. of Tech., Cambridge (USA). Aeroelastic and Structures Research Lab.). Sep 1978. Contract EY-76-S-02-4131. 259p. Dep. NTIS, PC A12/MF A01.

The material is presented as far as possible in the form of charts, either tables or graphs, from which specific design information may be selected or trends determined without the need for computational facilities. For design purposes, or when attempting to correct a design deficiency, trends are frequently more useful than absolute information. Since it is impossible to cover all possible configurations for a system with as many parameters as a wind turbine, interpolation will be necessary in many cases.

20507 (COO—4131-T1(Vol.8)) **Free wake analysis of wind turbine aerodynamics. Wind energy conversion. ASRL-TR-184-14.** Gohard, J.C. (Massachusetts Inst. of Tech., Cambridge (USA). Aeroelastic and Structures Research Lab.). Sep 1978. Contract EY-76-S-02-4131. 294p. Dep. NTIS, PC A13/MF A01.

The underlying theory is presented for determining blade and rotor/tower vibration and dynamic stability characteristics as well as the basic dynamic (as opposed to aerodynamic) operating loads. Starting with a simple concept of equivalent hinged rotors, the equations of motion for the blade including pitch, flap and lag motions are developed. The nonlinear equations are derived first and linearized about a finite displacement of the blade out of the plane of rotation. This is important since wind turbines tend to operate at relatively high coning angles. The effect of distributed flexibility, as opposed to the equivalent hinge concept, is then discussed.

20508 (DOE/R5/10120—T1) **Wind to heat convertor. Technical progress report.** Fisher, E.D. (Fisher (Evan D.), Bellaire, MI (USA)). 28 Dec 1979. Contract FG02-79R510120. 20p. Dep. NTIS, PC A02/MF A01.

The purpose of this project is to demonstrate a wind driven machine which converts wind energy to heat through the action of the impellor of the windmill, driving through suitable shafting and gearing, a rotary hydraulic brake which absorbs the power by converting the mechanical energy into heat in the working fluid. Resistance is created exclusively by fluid friction and agitation of the fluid circulated between the vaned members of the convertor. This project includes the effort to design, purchase component parts and materials, construct, assemble, erect the prototype model, and evaluate its performance under the prevailing wind conditions at the selected site.

20509 (RFP—3026/3533/79-6) **Dunlite model 81/002550. Performance report.** Higashi, K.K. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). Jul 1979. Contract AC04-76DP03533. 12p. Dep. NTIS, PC A02/MF A01.

This report is designed to provide data which give an accurate picture of the performance of the Dunlite Model 81/002550 under conditions of normal use. Every effort has been made to ensure that the data provided in this report are accurate. The calibration of all instruments is continuously maintained. The tests for the Dunlite wind system are designed to determine the power curve under various load (application) configurations and determine the ability of the machine to survive high winds (85 mph or greater). Interface with Enertech Corporation occurred only when replacement parts were required. The manufacturer has been provided with monthly preliminary data reports from Rocky Flats.

20510 (RFP—3028/3533/79-12) **Dunlite-model 81/002550 wind turbine generator. Failure analysis.** Higashi, K.K.; Carr, M.J.; Grotzky, V.K. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1 Jun 1979. Contract AC04-76DP03533. 22p. Dep. NTIS, PC A02/MF A01.

Optical and Scanning Electron Microscope examinations of a failed blade from a Dunlite Wind Turbine Generator were made to determine the mode of failure. The failure was a fatigue failure which began on the flat or upwind side of the blade. The mode of loading this area was reversed bending about an axis perpendicular to the long axis of the blade and in the plane of the sheet. The fatigue crack propagated around the blade until the blade finally failed by ductile overload processes.

20511 (RFP—3033/3533/79-4) **Altos-model 8B wind turbine generator. Performance report.** Higashi, K.K. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). Jul 1979. Contract AC04-76DP03533. 13p. Dep. NTIS, PC A02/MF A01.

This interim report is designed to provide preliminary data on the performance of the Altos, Model 8B, under conditions to which it is likely to be subjected while in normal use. All instruments used during the testing of the Altos were maintained in calibration and in accordance with Rocky Flats calibration procedures. The data provided in this report are accurate within the calibration specifications. The tests for the Altos wind system are designed to develop power curves under various load configurations and determine the ability of the machine to survive high winds (85 mph or greater). Contact with Altos Corporation concerning machine performance and repairs has been accomplished with relative ease. Response times have been good, and system modifications have been accomplished in a timely manner. The manufacturer has been provided with monthly preliminary data reports.

20512 (RFP—3035/3533-79/10) **Altos-model 8B wind turbine generator. Failure analysis.** Higashi, K.K.; Carr, M.J. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 18 Jun 1979. Contract AC04-76DP03533. 20p. Dep. NTIS, PC A02/MF A01.

A brittle failure of a hub on an Altos wind turbine generator tested at the Rocky Flats Small Wind System Test Center was caused by the combination of a poor quality (porous) casting and a sharp corner in a machined keyway.

20513 (SAND—79-1990) **Comparison with strain gage data of centrifugal stresses predicted by finite element analysis on the DOE/Sandia 17-m Darrieus turbine.** Watson, R.A. (Sandia Labs., Albuquerque, NM (USA)). Feb 1980. Contract EY-76-C-04-0789. 20p. Dep. NTIS, PC A02/MF A01.

By the use of strain gages, the blade structural response to purely centrifugal loading was measured on the DOE/Sandia 17-m Darrieus rotor. The measurements obtained are compared in this report with MARC-H nonlinear finite element stress predictions. It was necessary to include gravitational effects in the finite element model to explain certain asymmetries in the data. The model with gravitational effects shows good agreement with the data. Examination of results suggests that refinement of the model to include more structural detail in the region where the blade joins the tower would probably enhance the accuracy of the model.

20514 (SERI/TP—635-469) **Review of the current status of the wind energy innovative systems projects.** Vas, I.E. (Solar Energy Research Inst., Golden, CO (USA)). Mar 1980. Contract EG-77-C-01-4042. 77p. Dep. NTIS, PC A05/MF A01.

Information is presented concerning theoretical and experimental studies on giromill turbines; diffuser augmented turbines; tornado turbines; electrofluid dynamic generators; Madaras rotors; the vortex augmented turbines; and cooling tower thermodynamic cycles.

20515 (SERI/TP—31-248(Vol.2)(Pt.2), pp 569-576) **Wind energy design.** Grover, R.D. (Sandia Labs., Albuquerque, NM). Oct 1979.

From Reliability of materials for solar energy workshop; Denver, CO, USA (18 Dec 1978).

At present Sandia Laboratories has three vertical axis wind turbines (VAWTs) in operation near Albuquerque, NM. Blades on these VAWTs are 17-m, 5-m, and 2-m in diameter. The 17-m VAWT has been tested for 2 years in both two- and three-bladed configurations. The 5-m VAWT has been tested for 5 years, again in both two- and three-bladed configurations. The 2-m VAWT is a wind tunnel model that has been tested for only 1 year in both two- and three-bladed configurations. All three turbines have blade diameters at blade centerlines that are the same as the blade height, for a height-to-diameter (H/D) ratio of 1:1.

20516 (SERI/TP—31-248(Vol.2)(Pt.2), pp 577-586) **Design parameters for small wind systems.** Boland, J.F. Oct 1979.

From Reliability of materials for solar energy workshop; Denver, CO, USA (18 Dec 1978).

The Rocky Flats Wind Systems Program, operated for the Department of Energy by Rockwell International, was organized in 1976 to support DOE (then ERDA) in establishing small wind energy conversion systems as a viable, cost-effective alternate energy source. These small systems would have outputs less than 100 kW and typical rotor diameters less than 30 m (100 ft). To provide data helpful in this development work, a test center for small wind systems has been established at the DOE Rocky Flats Plant about 30 miles northwest of Denver. When fully operational, this center will be capable of simultaneously field testing up to 50 small wind systems. Commercially available systems are now beingg tested at

this facility. In the future, testing will be conducted on prototype systems being developed by private industry either independently or with financial support from DOE. Data obtained during the performance and reliability testing at Rocky Flats will be available, through reports, to the manufacturers and the general public.

20517 (SERI/TP—31-248(Vol.2)(Pt.2), pp 587-597) **Fretting and fatigue in wind energy systems.** McEvily, A.J. (Univ. of Connecticut, Storrs). Oct 1979.

From Reliability of materials for solar energy workshop; Denver, CO, USA (18 Dec 1978).

The successful design of a wind energy system must take into account the fretting and fatigue resistance of the materials utilized. In order to illustrate the nature of the design procedure and the types of materials involved, a particular example will be used, namely the 150 ft wind turbine blades designed and fabricated by the Kaman Aerospace Corporation for the NASA Lewis Research Center.

20518 (SERI/TP—31-248(Vol.2)(Pt.2), pp 599-612) **Graphite-aluminum composite technology.** Meyerer, W.; Paprocki, S. (Material Concepts, Inc., Columbus, OH). Oct 1979.

From Reliability of materials for solar energy workshop; Denver, CO, USA (18 Dec 1978).

Conventional and advanced fiber-reinforced-nonmetal matrix composites are, at present, highly competitive with metal-matrix composites (MMCs) from the standpoints of design, confidence, and cost. The specific properties of tensile stress and elastic modulus of certain fiber-reinforced epoxy composites are extremely high and can be easily utilized in applications in which ambient temperatures prevail and in environments of limited severity. Metal-matrix-composite technology is presently at a point that is comparable to the early 1960s development of nonmetals composites. It is in its infancy, but it is rapidly emerging from that stage and deserves attention as complementary technology. The fact of its being complementary is of great importance. Metal-matrix-composite technology is an offshoot of the same development that produced graphite-epoxy composites and in the future, may very well carry composites into applications not feasible for plastics.

POWER CONVERSION SYSTEMS

20519 (DSE—2332-T3) **System dynamics of multi-unit wind energy conversion systems application. Appendices. Final report.** Macklis, S.L. (General Electric Co., Philadelphia, PA (USA). Valley Forge Space Center). Feb 1978. Contract EX-76-C-01-2332. 284p. Dep. NTIS, PC A13/MF A01.

Fluctuation in wind speed causes a variability in wind power output which is unique among utility level power sources. It is important that the feasibility and the constraints of installing a significant number of wind turbine generators into the national power system be investigated. The objective of this study is to determine the effect of wind variability and wind machines on the stability of the electrical power system and to provide design information for the machine designer and the utility user.

20520 (NMEI—44) **Variable speed constant frequency voltage generator (alternator). Final report.** Grannemann, W.W. (New Mexico Univ., Albuquerque (USA). New Mexico Energy Inst.). Jul 1979. 43p. New Mexico Energy Inst., Albuquerque.

The objective of constructing the first prototype alternator with digital control of its output frequency for a variable shaft speed, such as a wind machine would have, is described. Each component part and the fundamental principles of the system have been tested and proven as workable. The first machine is a two-pole alternator with power removed from the rotor through slip rings. The rotating field in the stationary coils of the stator is controlled by the microcircuits. Later, alternators may well have the control circuits and rotating field in the rotor which would be a significant improvement since power would not need to be removed through slip rings. Except for the power amplifiers which drive the stator windings, the control and the comparison circuitry is constructed with available low cost, low power integrated circuits (IC's).

20521 (SERI/TP—351-546) **Problems in the integration of intermittent sources into utility production costing models.** Fegan, G.R.; Percival, C.D. (Solar Energy Research Inst., Golden, CO (USA)). Jan 1980. Contract EG-77-C-01-4042. 5p. (CONF-800421—2). Dep. NTIS, PC A02/MF A01.

From IEEE international symposium on circuits and systems; Houston, TX, USA (28 Apr 1980).

The intermittent generation source, a source over which the utility dispatcher has minimal control with regard to power availability, presents serious problems to the utility planner in terms of reliability, determination of worth, and inclusion in expansion plans. The problems involved with the integration of photovoltaic cells, wind machines, and other renewable sources with limited storage into utility production cost models are unfortunately a function of the different resources. The problems are differentiated into those dealing with renewable resources which are correlated to the demand and those dealing with renewable resources which appear to act independently of demand. Solutions for the later situation are given; approaches to solutions for the former are explored as is the practicality of the approaches.

SITE CHARACTERISTICS

REFER ALSO TO CITATION(S) 20503

20522 (RLO—2227-T24-79/1) **Vegetation as an indicator of high wind velocity. Final report, June 15, 1978-June 14, 1979.** Hewson, E.W.; Wade, J.E.; Baker, R.W. (Oregon State Univ., Corvallis (USA). Dept. of Atmospheric Science). Jun 1979. Contract EY-76-S-06-2227-024. 50p. Dep. NTIS, PC A03/MF A01.

To use wind energy the resource must first be identified. This report describes techniques for using two widely distributed species of coniferous trees - Douglas-fir and Ponderosa Pine - as aids in wind-power prospecting. The report describes the need for the research, the effects of wind on trees, development of the indices of wind deformation and calibration of these indices to the mean annual wind speed. Results up to this time indicate trees can be used to estimate mean annual wind speed and these estimates, although subject to some uncertainty (about +- 20%), are sufficiently sensitive to be used as an initial criterion for ranking potential sites in terms of wind-power potential prior to instrumentation with anemometers.

20523 (RLO—2343-79/2) **Guide to the interpretation of wind-flow characteristics from eolian landforms.** Marrs, R.W.; Gaylord, D.R. (Wyoming Univ., Laramie (USA). Dept. of Geology). Apr 1979. Contract EY-76-S-06-2343. 48p. Dep. NTIS, PC A03/MF A01.

This guide to interpreting eolian landforms summarizes techniques used in interpreting wind patterns from eolian features which can be remotely identified and mapped. They include: interpretation of wind direction, wind energy, and wind velocity from sand dunes and dune fields; interpretation of wind direction and wind velocity from playas; and interpretation of wind direction and relative wind velocity from scour streaks, dust and smoke plumes, vegetation streaks, and snowdrifts.

20524 (UHMET—79-05) **Project Ahupua'a: solar meteorological field measurements on the Island of Hawaii, summer 1978. 3. Trade wind interactions with local winds in South Kohala.** Schroeder, T.A. (Hawaii Univ., Honolulu (USA). Dept. of Meteorology). Feb 1980. Contract AC03-79ET20184. 68p. Dep. NTIS, PC A04/MF A01.

Instrumented vans monitored meteorological elements related to solar energy in the leeward South Kohala district of the Island of Hawaii between 23 and 28 June 1978. This phase of Project Ahupua'a concentrated on sea breeze circulations and their interactions with synoptic scale winds. Supplementary data were collected as in previous phases. In addition, visual observations were made from Anaehoomalu Beach and from an automobile traversing the transect. Daily weather conditions were documented by ground-based photography. The study period was characterized by abnormally high tropospheric moisture content and passage of significant tradewind disturbances. Local weather variability was greater than in earlier phases of project Ahupua'a. Sea breeze intrusion was frequent below 300 m MSL, but occurred at higher elevations only in response to significant synoptic systems. Diurnal variations of measured parameters were strong and reflected diminished sea breeze influence above 300 m. Heating of lava surfaces drives local circulations through two opposing physical processes. Surface pressure gradients support sea breeze development while vertical transport of horizontal (trade wind) momentum creates intense downslope flows. A model of sea breeze variability is proposed. Under synoptic scale trade wind flow, clear skies permit maximum heating of the lava, enhancing vertical transports of horizontal momentum so that the sea breeze is overpowered. Synoptic scale cloudiness (moisture) and stability are moderating influences. A numerical experiment is proposed to test the model.

ELECTRIC POWER ENGINEERING

POWER PLANTS AND POWER GENERATION

REFER ALSO TO CITATION(S) 20025, 20749

20525 (DOE/RA/08137—T1) **California Energy Commission staff paper. Issues related to reliability of power plants in California.** Shurley, L.A. (California Energy Commission, Sacramento (USA)). Dec 1979. Contract FC01-77RA08137. 65p. Dep. NTIS, PC A04/MF A01.

This paper reflects the concern that without reexamination on the part of the industry of its past policies, traditions, and practices, the power plants yet to be licensed in the State of California may not fulfill their full productivity potential. Also, this document seeks a recognition of all parties participating in the regulatory processes, that unless appropriate and deliberate measures are applied, the reliability of the future power generating facilities may be inconsistent with the energy needs, and consequently the reliability deficiency may have to be compensated for by construction of additional generating units that otherwise should not be required. Accordingly, the causes and factors contributing to degradation of power plants reliability are identified, and various means of reduction (or elimination) of such causes, along with related economic aspects are discussed. Basic policies derived from the statutory requirements, the ensuing Commission's role, and the role of the Commission's staff relative to the reliability issues are identified. The contents of this document are applicable to any type of baseload power generating facility. The provided record, pointing to the need for reliability improvement, covers the history of nuclear, geothermal, coal, gas, and oil-fired units. The record encompasses variables such as the generating unit size (MW) and the plant maturity (age). Also, certain facilities with exceptional productivity levels, which resulted from specific measures taken to achieve them, are identified. In addition to the specific measures that can be taken to increase the power plant's reliability, the recommendation to study the merits of incentivising the power industry to improve the productivity levels of future power plants is included.

20526 (DOE/RA/08137—T1(App.2)) **Power plant performance analysis and guidelines study. Appendix II. Reliability and efficiency indices.** Keller, R.W.; Bhatla, A.; Smith, M.J. (System Development Corp., Santa Monica, CA (USA)). Jun 1978. Contract FC01-77RA08137. 67p. Dep. NTIS, PC A04/MF A01.

Four indices of power plant performance have been identified for use by the CERCDC in the technical evaluation of cost-effective levels of reliability and efficiency of future power plants, to be sited in the State of California. The selected indices are Capacity Factor, Operating Availability, Equivalent Availability, and Heat Rate. The write-up on each index includes a discussion on the Index Definition, Historical Data Availability/Sources and Recommendations for Application by the Commission.

20527 (DOE/RA/08137—T1(App.3)) **Power plant performance analysis and guidelines study. Appendix III. Reliability and efficiency index data.** Keller, R.W.; Bhatla, A.; Smith, M.J. (System Development Corp., Santa Monica, CA (USA)). Jun 1978. Contract FC01-77RA08137. 230p. Dep. NTIS, PC A11/MF A01.

Historical data from the EEI, FPC, NRC, FEA, and participating utilities were evaluated for each of the four reliability and efficiency indices recommended to the California Energy Commission. Data were not available for all unit sizes for the full period 1971 to 1975. However, the available data were analyzed to arrive at historical averages and ranges of averages for each of the recommended indices. Feasible ranges and averages of each index for units of different sizes and fuel types are presented and trends for each index are discussed with respect to characteristics such as unit age, maturity, equipment problems, etc. The recommended application of these data to the power plant Reliability and Efficiency Guidelines are discussed in the main body of this report (Section B).

20528 (DOE/RA/08137—T1(Summ.)) **Power plant performance analysis and guidelines study. Summary report.** Keller, R.W.; Bhatla, A.; Smith, M.J. (System Development Corp., Santa Monica, CA (USA)). Jun 1978. Contract FC01-77RA08137. 57p. Dep. NTIS, PC A04/MF A01.

The objectives and intent of this study were to: identify power plant performance indices, and data sources; tabulate the historical performance of power plants on a national and California basis; assess the impact of plant design and construction procedures, site and regulatory factors, contract procedures, plant operation and maintenance factors and other factors which affect power plant reliability and efficiency; determine issues which must be addressed by utilities in proposing the most cost-effective levels of reliability and efficiency in power plants; and recommend guidelines and follow-up procedures that might be implemented by the Commission to assess and bring about improvements in the performance of new plants. As a result of this study a two part guideline was developed to ensure that the most cost-effective levels or ranges of reliability and efficiency will be obtained by new plants to be sited in California. The first part addresses the utilities establishment of the most cost-effective levels or ranges of reliability and efficiency for new plants within the existing utility electric generation and supply system. The second part is to be used to insure that specific actions will be taken by the utility to achieve the established reliability and efficiency levels or ranges in the most cost-effective manner. Four indices of power plant performance were recommended for use by the utilities and Commission in assessing the reliability and efficiency proposed for the generating facility(ies). These indices are: Capacity Factor; Equivalent Availability; Operating Availability; and Heat Rate. (LCL)

20529 (PB—297965) **Coal-fired powerplants' federal permit status report.** (Office of Management and Budget, Washington, DC (USA)). Apr 1979. 89p. NTIS PC A05/MF A01.

This report was prepared by the Federal Permit Review Assessment Task Force. The purpose of the study was to determine the major federal permits required for coal-fired powerplants and the facilities presently in the federal permitting process. This effort represents the first time the federal government has determined the status of each coal-fired powerplant now in the federal permitting process. The report contains information on 87 coal-fired generators which have applications pending, 113 units planned for the future, and 103 which have received permits.

COOLING AND HEAT TRANSFER EQUIPMENT AND SYSTEMS

REFER ALSO TO CITATION(S) 20514

20530 (EPRI-FP—1279(Vol.1)) **Validation of cooling tower analyzer (VERA). Volume 1. Experimental and predictive comparisons using the TACT computer program. Final report.** Penney, T.R.; Spalding, D.B. (CHAM of North America, Inc., Huntsville, AL (USA)). Dec 1979. 340p. Dep. NTIS, PC A15/MF A01.

CHAM of North America, Incorporated has developed and validated for the Electric Power Reseach Institute (EPRI) under Research Project 1262-1 (CHAM Reference H3205) a computer code that models the fluid flow, heat transfer, and mass transfer in wet Natural Draft Cooling Towers. The major tasks of this work involved: obtaining a variety of ambient, geometric, and other physical parameters that characterize the Natural Draft Towers currently in operation in the US and in some European countries; obtaining a comprehensive set of performance test data on these towers; comparing theoretical predictions with the performance data collected. The documentation of the validation of the computer program is presented along with parametric sensitivity studies in Volume 1.

20531 (EPRI-FP—1279(Vol.2)) **Validation of cooling tower analyzer (VERA). Volume 2. User's manual for TACT (thermal analyzer for cooling towers). Final report.** Penney, T.R.; Rosten, H.I. (CHAM of North America, Inc., Huntsville, AL (USA)). Dec 1979. 250p. Dep. NTIS, PC A11/MF A01.

Volume 2 is a user's manual for the validated computer code TACT. The mathematical foundation of the calculation procedure, a description of the program structure with the necessary FORTRAN input variables, a listing of the validated code, and a typical printout of input and output data are included.

POWER CYCLES

20532 (CONF-790631—17) **Design of land-based, foam OTEC plants for bottoming cycles.** Molini, A.E.; Zener, C.; Fort, T. Jr.; Santiago, M.; Herrera, A.; Lopez, J.A.; Martinez, R. (Carnegie-Mellon Univ., Pittsburgh, PA (USA); Puerto Rico Univ., Mayaguez). 1979. Contract EG-77-S-02-4459. 6p. Dep. NTIS, MF A01.

From 6. OTEC conference; Washington, DC, USA (19 Jun 1979).

Portions of document are illegible.

Open cycle OTEC technology suggests new concepts for the embediment of commercially feasible bottoming processes to recover energy from, and simultaneously minimize the environmental impact of, hot industrial effluents. The approach would make pollution abatement more economically attractive, yielding clean, low temperature flue gases while recovering a large portion of their thermal energy as electricity. The technology opens the use of lower quality fuels without fear of air pollution caused by their flue gases. Scrubbing would clean and cool the gases, yielding a hot fluid which after proper treatment would serve as the working fluid for open cycle systems using ambient air as the heat sink. Preparatory to demonstrating the Foam Energy Recovery Open Cycle System (FEROCS) at a 1 MW - 10 MW scale, a structural design was initiated for a unit 380 ft high visualized as an inverted, vertical, reinforced concrete U tube of 36 ft I.D. and walls 11 in. thick. The structure is feasible based on present construction practices with reinforced concrete in Puerto Rico. It would cost approximately $1.4 MM and consume 3800 yds^3 of concrete and 860 tons of reinforcing steel. To accelerate the demonstration of FEROCS, it is proposed to utilize artificially created temperature differences that can be readily obtained between industrial thermal effluents, for example flue gases at > 250°F from fossil fuel fired steam generating plants, as the heat source and ambient air as the heat sink. Results are presented of a study made conceptualizing the process using different scrubbing-working fluids.

20533 (CONF-800302—5) **Effect of pressure and turbine inlet temperature on the efficiency of pressurized fluidized bed power plants.** Graves, R.L. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-75-ENG-26. 24p. Dep. NTIS, PC A02/MF A01.

From 25. international gas turbine conference; New Orleans, LA, USA (9 Mar 1980).

The difficulties encountered in past and present efforts to operate direct coal-fired gas turbines are substantial. Hence the development effort required to assure a reliable, high-temperature pressurized fluidized bed (PFBC) combined cycle may be very expensive and time consuming. It is therefore important that the benefit of achieving high-temperature operation, which is primarily increased efficiency, be clearly understood at the outset of such a development program. This study characterizes the effects of PFBC temperature and pressure on plant efficiency over a wide range of values. There is an approximate three percentage point advantage by operating at a gas turbine inlet temperature of 870° instead of 538°C. Optimum pressure varies with the gas turbine inlet temperature, but ranges from 0.4 to 1.0 MPa. An alternate PFBC cycle offering high efficiency at a peak temperature of about 650°C is also discussed.

20534 (EPRI-AF—1288) **Economic evaluation of GCC power plants based on the STEAG combined-cycle design and comparison with a US combined-cycle-based system. Final report.** Coleman, B.S.; Crawford, C.D.; Joiner, J.R. (Fluor Engineers and Constructors, Inc., Irvine, CA (USA)). Dec 1979. 320p. Dep. NTIS, PC A14/MF A01.

The results of preliminary process design and economic screening studies of four integrated gasification-combined-cycle (GCC) power plant systems are presented. Three of these GCC systems were based on the pressurized boiler combined-cycle design developed and demonstrated by STEAG in West Germany. As a basis for comparison, the fourth GCC system utilized a typical US combined-cycle configuration as designed by United Technologies Corporation. All of the combined-cycle designs presented used commercially available components, including the gas turbines. The gasification processes used in the three STEAG-based GCC systems included the air-blown Lurgi dry ash process, the oxygen-blown Texaco entrained-bed process, and the air-blown Texaco entrained-bed process. The US combined-cycle-based GCC system also utilized the oxygen-blown Texaco process. All evaluations were based on complete "grass roots" facilities sized to conform to a baseload power plant of approximately 1000 MW capacity. The US combined-cycle-based GCC system yielded both the highest overall thermal efficiency (34.8%) and the lowest first-year busbar cost (38.9 mills/kWh). It was concluded that the three specific STEAG-based GCC systems provide no incentive for their development and use by the US electric power industry. Of these three STEAG-based systems, the design which employed the oxygen-blown Texaco gasification process showed the most potential for improvement. It was also concluded that both the results and the suggested improvements in the STEAG-based designs provide no evidence to suggest that the STEAG combined cycle is superior to the US combined cycle in a GCC system application.

WASTE-FUELED SYSTEMS

20535 (CONF-790749—, pp 258-269) **Resistance of thermal barrier ceramic coatings to hot salt corrosion.** McKee, D.W.; Luthra, K.L.; Siemers, P.; Palko, J.E. (General Electric Co., Schenectady, NY). Dec 1979.

From Conference on advanced materials for alternate fuel capable directly fired heat engines; Castine, ME, USA (30 Jul 1979).

Plasma-sprayed Y_2O_3-ZrO_2 coatings are stable in oxidizing gases at high temperature but may be liable to premature failure in the presence of salt deposits. Molten sodium sulfate, commonly formed on gas turbine hot section components, can penetrate the pore network of the ceramic, cause hot corrosion/sulfidation of the alloy substrate and initiate cracking of the ceramic layer. Vanadium impurities in salt deposits can react with the Y_2O_3 component of the ceramic, which becomes destabilized and spalls readily. Improvements in coating life in the presence of salt deposits may be expected if the interconnected porosity of the plasma-sprayed coatings can be eliminated and the Y_2O_3 content of the coating increased.

COMPONENTS

REFER ALSO TO CITATION(S) 19903, 20019, 20533, 20897, 20916, 21044, 21046

20536 (CONF-790749—, pp 163-187) **Field testing and evaluation of next generation industrial gas turbine coatings.** Schilling, W.F.; Fox, H.M.; Beltran, A.M. (General Electric Co., Schenectady, NY). Dec 1979.

From Conference on advanced materials for alternate fuel capable directly fired heat engines; Castine, ME, USA (30 Jul 1979).

General Electric has chosen the rainbow rotor concept as the means for evaluating a variety of bucket coating compositions and processes under field conditions. Comprehension metallographic evaluations have been performed on GE/ARAMCO Phase I and Phase II rainbow rotor buckets after 19 842 and 13 051 fired hours, respectively. Both of these units burn sour (> 3% H_2S) natural gas. Two of four diffusion-bonded claddings evaluated performed in an excellent manner. Testing the Fe-Cr-Al-Y (2541) cladding in the Lynn and ARAMCO Phase II machines resulted in only minor attack. Virtually unattacked during the 13 051-hour Phase II operation was the aluminided S-57 cladding. The Ni-50Cr cladding performed poorly in both the Lynn and Phase II machines. Excellent behavior was the assessment rated for the Pt-Cr-Al pack diffusion coatings after exposure in the Lynn and ARAMCO Phase I and Phase II machines. Although the aluminided electron-beam Co-Cr-Al-Y (2961) and Co-35Cr coatings were found internally oxidized (65 microns and 80 microns, respectively) after 5000 hours in the Lynn machine, these coatings were visually observed to be in excellent condition after 10 000 and 19 000 fired hours. The plasma-sprayed Co-Cr-Al-Y (2961) coating was in excellent condtion (50-micron penetration) after the 13 051-hour ARAMCO Phae II service. Other details are given in its report. (LTN)

20537 (CONF-790749—, pp 270-286) **Erosion/hot corrosion laboratory evaluation of metallic alloys and coatings.** Barkalow, R.H.; Pettit, F.S. (Pratt and Whitney Aircraft Group, Middletown, CT). Dec 1979.

From Conference on advanced materials for alternate fuel capable directly fired heat engines; Castine, ME, USA (30 Jul 1979).

Of the possible degradation mechanisms due to particle-laden gas streams in alternate fuel capable turbine engines, the two most serious appear to be erosion-hot corrosion interactions and mechanical or chemical effects of ash fouling. The solution to these problems will undoubtedly involve both materials and design considerations. Materials must be as resistant as possible, then the gas clean-up system must be as good as necessary, at the expense of capital cost and energy efficiency. It seems clear that the type of erosion-hot corrosion interactions described are capable of causing unacceptable rates of materials degradation, even under conditions where the additive effect of corrosion and particulate erosion acting along would be tolerable. It will apparently be necessary either to avoid one of the partial processes entirely or to limit both to very small rates by a combination of materials selection, turbine design, and gas clean-up. The design or selection of materials - considering metallic alloys with high corrosion resistance and perhaps ceramic coatings with high erosion resistance as well - will be difficult but appears conceptually possible. Less clear is whether or not there is any materials solution to ash fouling; i.e. can one develop an anti-fouling coating, or is deposition behavior so strongly influenced by aerodynamic factors and ash chemistry that it is essentially independent of the type of material. Results to data imply the latter, alghough it must be emphasized that only a limited range of test conditions has been used. The type of burner rig experiments described in this paper offers the opportunity of investigating the wide range of specimens and environmental conditions which must be studied to determine degradation mechanisms and evaluate candidate materials for alternate fuel capable engines.

20538 (CONF-790749—, pp 287-300) **Description of program to develop combustion turbine design guidelines based on deposition/corrosion considerations.** DeCorso, S.M.; Vermes, G. (Westinghouse Electric Corp., Concordville, PA). Dec 1979.

From Conference on advanced materials for alternate fuel capable directly fired heat engines; Castine, ME, USA (30 Jul 1979).

A test program is underway which will provide deposition/corrosion guidelines for the design of reliable utility turbines running on low quality fuels at high cycle efficiencies. The program philosophy is based on similar programs which provided successful machines for the utility industry. Since deposition might become more significant than hitherto, the test program is geared towards the quantitative assessment of deposition as well as corrosion.

20539 (CONF-790749—, pp 301-330) **Recent advances in the theory of salt/ash deposition in combustion systems.** Rosner, D.E.; de La Mora, J.F. (Yale Univ., New Haven, CT). Dec 1979.

From Conference on advanced materials for alternate fuel capable directly fired heat engines; Castine, ME, USA (30 Jul 1979).

Gas turbine development is being impeded by performance losses and hot corrosion of components resulting from the deposition of inorganic salts (e.g., Na_2SO_4) and oxides present in the combustion products. Engine operating experience and captive engine tests have provided valuable clues to such phenomena, but smaller-scale laboratory experiments under more precisely controlled conditions, coupled with necessary advances in deposition rate theory, will be necessary to obtain an improved understanding of the mechanisms of deposition on which future control measures can be based. We describe here recent theoretical and experimental studies directed at providing a sufficiently general, rational framework for future predictions of salt/ash deposition rates in the gas turbine GT and related combustion environments. A review of previous work on the mechanisms of deposition reveals that inadequate attention has been paid to

the effects of multicomponent vapor transport, thermophoretic transport of vapors and small particles to actively cooled surfaces, variable fluid properties within mass transfer boundary layers, and free stream turbulence. Moreover, insufficient attention has been paid to the transition between vapor transport behavior and particle transport behavior and interactions between the mechanisms of concentration diffusion, thermal diffusion and impaction. Recent advanced in some of these areas are described, along with information derived from new experimental techniques based on the on-line use of optical methods to rapidly probe deposition onset and rates in combustion systems. We conclude with an assessment of research needs.

20540 (CONF-790749—, pp 340-369) **Chemistry of sodium chloride involvement in processes related to hot corrosion.** Stearns, C.A.; Kohl, F.J.; Fryburg, G.C. (Lewis Research Center, Cleveland, OH). Dec 1979.

From Conference on advanced materials for alternate fuel capable directly fired heat engines; Castine, ME, USA (30 Jul 1979).

In general, environmental attach arises from synergistic combination of high temperatures, combustion products of the air and fuel burned, and impurities which enter the system with the air and/or fuel. Sodium chloride, NaCl, is one of the primary contaminants that enters the gas turbine engine and contributes to the degradation of hot-gas-path components. The role played by NaCl in the hot corrosion process has been difficult to define completely because the fate of the ingested contaminant is complex and there has been a lack of fundamental information on the various physical and chemical processes which take place as the NaCl proceeds through the gas turbine engine. In the hot corrosion literature one can easily find a number of misconceptions about the role of NaCl in the hot corrosion process. These misconceptions provided an initial stimulus for much of the research reported here. This paper is an overview of NASA-Lewis Research Center in-house and contract/grant supported programs directed toward obtaining an understanding of the chemistry of sodium chloride as related to processes involved in hot corrosion environmental attack. The chemical studies reviewed here have helped elucidate the possible roles that NaCl can play in the overall hot corrosion process. Beside being a source of sodium for the formation of corrosive liquid Na_2SO_4, the NaCl itself contributes in other indirect ways to the material degradation associated with the high temperature environmental attack.

20541 (CONF-790749—, pp 370-392) **Influence of erosion on high temperature corrosions.** Hancock, P.; Marie, A.R.I.; Nicholls, J.R. (Cranfield Inst. of Tech., Bedford, England). Dec 1979.

From Conference on advanced materials for alternate fuel capable directly fired heat engines; Castine, ME, USA (30 Jul 1979).

The use of an active or inert classification, for both the particles and environment, in conditions where both corrosion and erosion can occur simultaneously, can simplify the analysis of the complex interactions that occur so that the relative effects of ballistic damage and chemical attack can be separated. Accelerated oxidation can occur if sufficient inert erosive particles are present to break down the protective surface oxide scale on high temperature components, but accelerated corrosion can occur if the scale breakdown is caused by the action of active erosive particles. The degree of damage to the surface oxide scale is independent of the angle of impact but erosion resistance is improved with increased scale plasticity, which can result in lower measured corrosion rates of metal at higher exposure temperatures when corrosion-erosion conditions exist. At gas flows of 250m/sec inert particles of size below 45μm cause little scale damage to influence corrosion in scales of high plasticity, such as on Nickel 200, but these particles cause considerable scale spalling on Nimonic 105. Thus the minimum particle size to cause loss of protection depends upon the properties of the surface scale present on the alloy. Erosive damage is also influenced by the mechanical properties of the eroding particles; sand particles have been shown to cause considerably more mechanical surface damage than sea salt particles of comparable size, but their subsequent corrosive activity makes the latter potentially much more damaging. Both salt and sand particles fragment on impact, many of the fragments (10μm in size) stick to the metal surface. If these fragments are chemically active they can cause subsequent catastrophic corrosion if the scale has been damaged by their impact.

20542 (CONF-790749—, pp 393-402) **Advanced gas turbine coatings for minimally processed coal derived liquid fuels.** Boone, D.H. (Univ. of California, Berkeley); Shen, S.S.; Fairbanks, J.W. Dec 1979.

From Conference on advanced materials for alternate fuel capable directly fired heat engines; Castine, ME, USA (30 Jul 1979).

From experience with gas turbines burning clean fuels in clean environments as well as in marine and industrial environements it was found that the use of some type of protective coating is mandatory. A review of the research and development directions being pursued to meet the substrate material requirements finds that the processing techniques and alloys are getting more complicated and expensive. A similar review of the direction and progress in the development of oxidation and hot corrosion resistant coatings indicates, in general, a greater emphasis on the identification of suitably resistant compositions with much less attention being given to structural effects, substrate compatibility and methods of economical and reliable application. It is clear that advanced energy conversion systems will require the combination of a relatively complex system of substrate alloy, coating composition, and their relative fabrication techniques to obtain the necessary performance characteristics, efficiencies and durabilities. The use of protective coatings, with a composition tailored for a specific environment, applied as an overlay to a substrate alloy designed primarily for mechanical properties has become the basis for many advanced gas turbine engines. One method, the electron beam-physical vapor deposition process, EB-PVD, has been in production use for ten years for gas turbine airfoil systems and has been shown to be an economically viable manufacturing technique. In spite of this successful use in production, or possibly because of it, the full capabilities of the EB-PVD process to meet the new and more demanding requirements of the coating developer and turbine designer have been insufficiently documented in the literature.

20543 (CONF-790749—, pp 403-415) **Influence of dispersed phase particles on microstructure and properties of MCrAlY alloys: do we need to study it.** Bunshah, R.F. (Univ. of California, Los Angeles, CA). Dec 1979.

From Conference on advanced materials for alternate fuel capable directly fired heat engines; Castine, ME, USA (30 Jul 1979).

Overlay coatings of MCrAlY alloys (where M stands for Fe, Ni, Co, or Ni + Co) are used to protect high temperature alloys in the hot stage of the gas turbine engine from corrosion. Electron beam evaporation is the technology currently used in production, with sputtering and plasma spraying used on an experimental basis. It is important to realize that the high temperature alloy/overlay coating form a system. Structure/property relationships in high temperature alloys have been extensively studies. Similar studies on MCrAlY alloys produced by the deposition technologies have been sparse. It should be pointed out that self-supported shapes (e.g. sheet) of MCrAlY alloys can be easily produced by such vapor deposition technology and thus study of the structure/property relationships is eminently possible. One of the advantages of deposition technologies is the ability to tailor the microstructure within wide limits by changing deposition temperature, incorporation of stable dispersed phase particles, etc. In recent years, Professor Movchan of the Paton Electric Welding Institute and his co-workers have carried out a systematic study on the effect of dispersed phase particles on the microstructure, yield strength, creep strength, hardness, and cutility of Fe and Ni. These results show very interesting ductility maxima for appropriate microstructural conditions, which could possibly be of great utility in increasing the life of MCrAlY overlay coatings. These studies clearly point out the need to extend this work on microstructural modification to MCrAlY alloys. This paper reviews the literature and presents a case for the study of dispersions on the microstructure and mechanical properties of MCrAlY alloys. Preliminary results on the microstructure of an MCrAlY alloy containing dispersed phases are also given.

20544 (CONF-790749—, pp 416-447) **Corrosion evaluation of superalloys and metal coatings for combustion turbines utilizing alternate fuels.** Spengler, C.J. (Westinghouse Research and Development Center, Pittsburgh, PA); Lee, S.Y.; Scheirer, S.T. Dec 1979.

From Conference on advanced materials for alternate fuel capable directly fired heat engines; Castine, ME, USA (30 Jul 1979).

The objectives of this investigation were to: (1) evaluate alloys and coatings for use with fuels other than clean distillate oil; (2) select a test environment that would be simulative of the use of the alternate fuel in a combustion turbine, and (3) to investigate the mechanisms of corrosion attack with the various alternate fuels, and if possible, relate the mechanisms to alloy composition and coating process variables. The alternate fuels investigated consisted of salt-contaminated sour natural gas, crude and heavy petroleum oils (with and without chemical additives to mitigate the effects of sodium and vanadium), and a surrogate for a coal-derived liquid fuel. It has been demonstrated that the possibility of accelerated corrosion attack in combustion turbines can be answered with a combination of approaches such as a protective coatings and additives. The simulation of alternate fuels can be accomplished with use of surrogate fuels in the pressurized test passage. Once the environmental effect of a particular simulated alternate fuel is ascertained then the response to the use of the fuel can be determined, that is, fuel pre-treatment (water-washing, additive additions) use of more corrosion resistant superalloys or types and compositions of protective coatings. It was established that there was a wide response of superalloys and coatings to the simulated combustion environments. Some hot corrosion resistant compositions (CoCrAlY) did not have useful life in vanadium-containing fuels. The most universally useful composition among those tested appears to be, on the basis of the various exposures, the Pt-containing NiAl diffusion coating.

20545 (CONF-790749—, pp 473-488) **Advanced coating development for industrial/utility gas turbine engines.** Goebel, J.A. (Pratt and Whitney Aircraft, East Hartford, CT). Dec 1979.

From Conference on advanced materials for alternate fuel capable directly fired heat engines; Castine, ME, USA (30 Jul 1979).

Based on the results of burner rig hot corrosion testing, two experimental coating compositions have been selected for coating application process evaluation and engine verification testing. The compositions selected are given along with the corresponding experimental alloys tested. It is believed that the two experimental coating compositions will provide low temperature corrosion resistance superior to IM6250, while still providing adequate high temperature resistance. Engine test performance of the experimental coatings will be compared to new IM6250 baseline coatings to provide a basis for relating engine test results to burner rig test results. Efforts involving the study of advanced coating concepts have been initiated. A number of experimental alloys have been prepared for oxidation and hot corrosion studies. Alloy compositions selected are expected to form oxide scales different in composition from those formed on current MCrAlY type coatings. Laboratory furnace tests will be used to assess the resistance of modified scales to hot corrosion.

20546 (CONF-790749—, pp 489-504) **Materials for power generation from refuse combustion.** Krause, H.H.; Cover, P.W.; Berry, W.E. (Battelle Memorial Inst., Columbus, OH). Dec 1979.

From Conference on advanced materials for alternate fuel capable directly fired heat engines; Castine, ME, USA (30 Jul 1979).

Energy recovery from municipal refuse by stam or power generation presents materials problems not encountered with fossil fuels. These problems result primarily from the chlorine in the refuse. However, metals such as zinc, lead, and tin also contribute to the unusually high corrosion rates encountered during refuse combustion. The performance of ordinary boiler tube steels, low- and high-chromium alloys, and an aluminized steel in this environment has been studied in the field by corrosion probe exposures. This work was supplemented by laboratory investigations to substantiate the proposed corrosion mechanisms under controlled conditions. Analyses of the incinerator flue gas streams, the bulk deposits on the probes, and the corrosion product scales have led to the conclusion that boiler deposits of metal chlorides are converted to HCl and chlorine by the action of sulfur oxides. These gaseous products formed within the deposit cause metal wastage which increases with: (1) the chlorine content of the fuel, (2) the metal temperature, and (3) the flue gas temperature. The role of the heavy metals apparently is to provide low-melting eutectics that enhance chlorine attack of the substrate metal. The high-chromium alloys and the diffusion-bonded aluminum coating have proven to be the most corrosion resistant materials under the incinerator operating conditions in exposures up to 800 hours. Incoloy 825, Types 310 and 347 stainless steel are the most resistant at high temperatures. However, the austenitic stainless steels are subject to stress-corrosion cracking if deposits become moist during boiler downtime. A co-extruded tubing of stainless steel over carbon steel or a diffusion-bonded aluminum coating may prove to be the most cost-effective materials for this service.

20547 (CONF-790749—, pp 505-521) **Silicon and chrome base coatings for stationary gas turbines.** Bauer, R.; Gruenling, H.W.; Schneider, K. (Brown, Boveri and Cie, Mannheim, Germany). Dec 1979.

From Conference on advanced materials for alternate fuel capable directly fired heat engines; Castine, ME, USA (30 Jul 1979).

Hot corrosion limits the lifetime of stationary gas turbine buckets. Chromium as well as silicon base coating systems have been developed due to their anticipated ability to form oxide layers with better chemical resistivity against high temperature corrosion attack. This paper summarizes laboratory test results and in-service experience of such coatings applied by packcementation, galvanic processes and plasma spraying. As an example the thermochemical degradation mechanism of a chromium diffusion coating on a first stage vane from a blast furnace gas turbine will be given. The observed lifetime of more than 35,000 hours is mainly due to the outward diffusion chromium from a chromium-rich reservoir layer through an overlying working layer with a constant chromium content. Comparable good experience has been had with galvanic chromium overlay coatings where α-Cr is acting like a reservoir layer. On the other hand silicon-rich packcementation coatings showed spalling-off as a consequence of the more brittle nature of the silicide phases. At the higher mechanical and thermal stresses of modern gas turbines, mechanical failure by cracking and spalling limits the use of such coatings with their layer-like structure and unavoidable phase boundaries. For superior properties at higher temperture, a Ni-Cr-Si plasma-coating with a ductile matrix and dispersed reservoir particles provides the best compromise between corrosion resistance and toughness. A series of engine results is presented emphasizing the effectiveness of this coating in prolonging the lifetime of turbine blades and vanes even under severe environmental conditions.

20548 (CONF-790749—, pp 542-581) **Thick ceramic coating development for industrial gas turbines: a program plan.** Vogan, J.W.; Stetson, A.R. (Solar Turbines International, San Diego, CA). Dec 1979.

From Conference on advanced materials for alternate fuel capable directly fired heat engines; Castine, ME, USA (30 Jul 1979).

NASA-Lewis -funded program plan is presented in which the effectiveness of thick ceramic coatings in preventing hot corrosion and in providing thermal insulation to gas turbine engine components will be investigated. Preliminary analysis of the benefit of the thermal insulating effect of such coatings on decreasing cooling air and simplifying component design appears very encouraging. The program is in the preliminary stages of obtaining starting materials and establishing procedures.

20549 (CONF-790749—, pp 582-605) **Ceramic coating evaluations and developments.** Bratton, R.J.; Lau, S.K.; Lee, S.Y.; Andersson, C.A. (Westinghouse Research and Development Centr, Pittsburgh, PA). Dec 1979.

From Conference on advanced materials for alternate fuel capable directly fired heat engines; Castine, ME, USA (30 Jul 1979).

This paper summarizes progress on a NASA/EPRI coatings program that has the objective to evaluate the resistance of present-day themal barrier coatings - all in the early stages of development - to combustion gases which are found in electric utility turbines fired on petroleum fuels of varying impurities. The sensitivity of the coatings to temperature, fuel impurity, pressure effects and water washing will be established as well as coating lifetime. The coatings are primarily plasma-sprayed, zirconium-based formulations deposited on superalloy test specimens that can be air cooled. Both duplex coating and graded coating systems are being evaluated. Test temperatures currently range from a gas temperature being evaluated. Test temperatures currently range from a gas temperature of 1900°F to 2300°F and from a substrate metal temperature of 1100°F to 1650°F. Fuel impurity sensitivity studies include the use of fuels that range from a clean GT No. 2 reference fuel to that doped with impurity levels which simulate both water-washed and untreated residual fuels. The clean fuel test results have been very encouraging in that failures were few. In the dirty fuel tests, mixed results were obtained with graded coatings performing much better than duplex coatings. The results are discussed in terms of the findings from protest studies. A new NASA/DOE program has the major objective to develop advanced ceramic coatings that will increase industrial/utility gas turbine hot section durability with heavy emphasis on operation with lower grade petroleum fuels and liquid coal-derived fuels.

20550 (CONF-790749—, pp 606-614) **Plasma-deposited thermal barrier coatings.** Taylor, T.A.; Price, M.O.; Tucker, R.C. Jr. (Union Carbid Corp., Indianapolis, IN). Dec 1979.

From Conference on advanced materials for alternate fuel capable directly fired heat engines; Castine, ME, USA (30 Jul 1979).

A program has been initiated to evaluate the thermomechanical stability of selected plasma deposited thermal barrier systems. All of the systems to be tested are of the two-layer (duplex) type with an oxide outer layer and MCrAlY and undercoat. Two oxide types are included: $MgO.ZrO_2$, because of its commercially-demonstrated, thermal shock resistance, and ZrO_2-20 wt/o Y_2O_3, because of it corrosion resistance and phase stability. The effects of oxide density and layer thickness are the major variables to be investigated. A CoNiCrAlY undercoat, selected for its resistance to both hot corrosion and oxidation, will be used on all test specimens. In addition, the advantages of an intermediate layer of chromium or nickel-chromium will be evaluated because of the promise they have shown in applications in marine diesel engines. The 22 variations of thermal barrier coating systems are to be tested in groups of four, designed so that several variables are constant, while others are changing within the group. The result is a test matrix of 13 groups of four to determine the optimum property for the large list of variables. Each thermal barrier system will be tested in duplicate and in some cases in triplicate. The total test program involves the thermal fatigue testing and isothermal air oxidation a 1850°F.

20551 (CONF-790749—, pp 615-628) **Development of sputter deposited multilayered ceramic/metal coatings.** Patten, J.W. (Pacific Northwest Lab., Richland, WA); Moss, R.W.; Bayne, M.A.; Hays, D.D.; McClanahan, E.D.; Fairbanks, J.W. Dec 1979.

From Conference on advanced materials for alternate fuel capable directly fired heat engines; Castine, ME, USA (30 Jul 1979).

Progress is reported on the development of sputter-deposited multi-layered ceramic/metal coatings wth the objective of increasing the durability of gas turbine combustion zone airfoils in coal-derived liquid fuels (or contaminated residual and conventional fuels). Combined mode dc/rf sputtering was used to make deposits consisting of alternate layers of Ni/ZrO_2 + Y or Ni-50 Cr/ZrO_2 + Y with a wide range of layer thicknesses and component gradients between layers. Cyclic thermal shock testing and bend testing of sputtered deposits consisting of alternate layers of Ni/ZrO_2 + Y or Ni-50 Cr/ZrO_2 + Y indicate that these deposits may be adherent to gas turbine airfoils

during a typical duty cycle. Segmented ceramic and metal layers on the order of 0.0025 cm thick resisted in-plane fracture. Pure ceramic layers greater than 0.0005 cm thick fractured in the deposit plane. Coated specimens with pure ceramic and ceramic + metal layers can now be provided for testing by manipulation of sputtering parameters. It is expected that the ceramic layers will provide erosion/corrosion resistance (and possibly thermal insulation) while the metal layers provide the required mechanical properties, i.e. thermal expansion compatibiltiy, resistance to impact damage, and containment of the ceramic layers. When a metal overlayer is lost to erosion/corrosion, the ceramic layer (possibly extensively fractured) is expected to remain adherent to the next metal underlayer.

20552 (CONF-790749—, pp 658-666) **Chemical vapor deposition of ceramic coatings and outerlayers.** Engdahl, R.E. (Deposits and Composites Inc., Herndon, VA). Dec 1979.

From Conference on advanced materials for alternate fuel capable directly fired heat engines; Castine, ME, USA (30 Jul 1979).

Two coating techniques are under development for use in gas turbines using coal derived fuels. One is to thermally process a NASA plasma sprayed coating by thermal cycling the assembly until a full crack pattern has emerged. To this thermally processed coating, a thin coating of titanium diboride or titanium diboride with silicon additions is applied to provide a source for a glassy sealing material. The second system utilizes small (.001 to .002 inch diameter) hollow spheres in conjunction with the NiCrAlY bond coat and follow-on ceramic (silicon nitride) overlayer to form an erosion resistant, low thermal conductivity layer with a small size, equiaxed, controlled structure. This layer is then sealed with titanium diboride or titanium diboride with silicon additions, to provide the glassy sealing material which will be retained in the small void areas formed by the hollow sphere structure. This location for the glassy material below the surface is required to prevent removal by the scrubbing and erosive action of the high velocity gas stream associated with gas turbine blades and vanes.

20553 (CONF-790749—, pp 667-679) **NASA progress on ceramic coatings for industrial/utility gas turbines.** Levine, S.R.; Hodge, P.E.; Miller, R.A. (Lewis Research Center, Cleveland, OH). Dec 1979.

From Conference on advanced materials for alternate fuel capable directly fired heat engines; Castine, ME, USA (30 Jul 1979).

Ceramic coatings for industrial/utility gas turbines are being investigated at NASA Lewis under the DOE sponsored Critical Research and Advanced Technology Project. The key variables controlling ceramic coating life in corrosive fuel combustion products were determined in burner rig tests of Na and V have been determined. Thermochemical calculations of condensate dew points and melting points combined with the temperature profile of the speciment were found to give a good explanation of observed coating failure locations. To further elucidate potential ceramic coating failure mechanisms, reaction studies between coating materials and potential impurities derived from the air, fuel or bond coat are being carried out. Advanced coatings are also being developed. A calcium silicate ceramic coating and a NiCrAlY/MgO cermet coating have performed substantially better than yttria-stabilized zirconia coatings in sodium plus vanadium contaminated fuel. Finally, the potential benefits of thermal barrier coatings on steam- and water-cooled gas turbines in a combined cycle have been determined.

20554 (CONF-790749—, pp 680-703) **Review of NASA therma barrier coating programs for aircraft engines.** Grisaffe, S.J.; Levine, S.R. (Lewis Research Center, Cleveland, OH). Dec 1979.

From Conference on advanced materials for alternate fuel capable directly fired heat engines; Castine, ME, USA (30 Jul 1979).

Increases in turbine inlet temperatures coupled with high engine pressure ratios have led to improved aircraft engine performance. Current goals are to continue to improve fuel efficiency by decreasing the use of cooling air as well as to improve engine durability. Thermal barrier coatings offer a potential means to achieve both goals. For this reason NASA-Lewis Research Center has both an in-house and a substantial contractual effort directed toward advancing thermal barrier coating technology. In-house efforts focus on compositional optimization of both the insulating ceramic outer layer and the metallic bond coating. Advanced compositions with twice the life of the early NASA coating have been identified. Degradation mechanisms and oxide properties are being examined to guide coating improvement. Contractually, one program is developing coatings as well as coating property data so as to provide a methodology whereby TBCs can be designed in and tailored for specific applications. Finally, a contractural effort has demonstrated the feasibility of closed-loop, computer-controlled, automated plasma spray coating.

20555 (CONF-790749—, pp 704-714) **Mechanisms of hot corrosion attack of ceramic coating materials.** Barkalow, R.H.; Pettit, F.S. (Pratt and Whitney Aircraft Group, Middletown, CT). Dec 1979.

From Conference on advanced materials for alternate fuel capable directly fired heat engines; Castine, ME, USA (30 Jul 1979).

The results to date support the following conclusions: as in the case of metallic systems, ceramics can undergo hot corrosion attack via either acidic or basic reactions. Yttria-stabilized zirconia, for example, is susceptible to selective removal of yttria by an acidic reaction, while silica-containing or silica-forming ceramics exposed to the same environmental conditions can degrade by a basic reaction. An important difference from the behavior of metals, however, is that hot corrosion of oxide ceramics appears to be a single stage fluxing process instead of the distinct initiation and propagation stages which are often discernable in the hot corrosion of metallic alloys. For the case of a non-oxide ceramic where a surface scale is of different composition than the bulk material (e.g. SiO_2 on Si_3N_4 or SiC), there could in principle be an intitiation stage in which a performed oxide layer remains intact followed by a propagation stage at this layer is penetrated. Even in such cases, however, significant differences from the initiation and propagation stages in metallic systems are to be expected, since the cation components of ceramics are in highly oxidized states compared to metallic systems. This condition therefore does not create nearly as large oxygen gradients across the salt layer, and sulfide formation is much less favorable.

20556 (CONF-790749—, pp 715-766) **High temperature technology program for a water-cooled gas turbine.** Caruvana, A.; Schilling, W.F. (General Electric Co., Schenectady, NY). Dec 1979.

From Conference on advanced materials for alternate fuel capable directly fired heat engines; Castine, ME, USA (30 Jul 1979).

The High Temperature Turbine Technology (HTTT) development programs have demonstrated the viability of producing water-cooled parts for a high temperature gas turbine. Only a number of the technology development programs leading to the demonstration of TRV have been described in this paper. References are recommended for further reading to fully understand the strong technology base that has been developed to support the design and test of a high temperature water-cooled gas turbine. The authors believe that demonstration of water-cooled gas turbine technology will provide an attractive alternative to some of the energy problems the world is now experiencing. It will provide for the use of a gas turbine in a base-load, combined-cycle that features fuel flexibility, lower cost of electricity and one that is environmentally acceptable.

20557 (CONF-790749—, pp 767-784) **Potential of rapid solidification rate alloys for gas turbine engines.** Cox, A.R. (Pratt and Whitney Aircraft Group, West Palm Beach, FL); van Reuth, E.C. Dec 1979.

From Conference on advanced materials for alternate fuel capable directly fired heat engines; Castine, ME, USA (30 Jul 1979).

A device for producing rapidly-solidified alloy powders was constructed which uses forced convective cooling of molten particles accelerated from a central source into a high conductivity gas quench medium. More than 200 experimental superalloy compositions have been atomized and evaluated to date. All fall within the general class of precipitation-hardening, nickel-base alloys but can be categorized further according to the following particulars: conventional precipitation-hardening superalloys; alloys normally referred to as D.S. Eutectic, alloys with high γ' concentrations (>60 a/o), or alloys based on the Ni-Al-Mo ternary. A series of powder consolidation and metalworking operations were carried out with the rapidly solidified powders, which included hot isostatic pressing extrusion, isothermal forging, and combinations thereof. Best results were achieved when the primary metalworking operation included relatively large deformations, especially with extrusion. The extension of rapid solidification processing to superalloy compositions allows alloy modifications to be made which are characteristically outside the range possible by current superalloy process methods. Eutectic regions are eliminated in γ-γ' alloys, so that higher additions of γ' partitioning elements can be added. BCC Mo occurrence in the Ni-Al-Mo-type alloys can be controlled through heat treatment to produce effectively dispersed phases. Incipient melt temperatures are high to enable effective heat treat, and adaptability of the powders to subsequent fabrication is achieved within reasonable engineering boundaries. Higher strength levels than now attained, as well as better second order properties, such as high modulus of elasticity and oxidation resistance, result because of the enhanced alloying capability possible with rapid solidification.

20558 (CONF-790749—, pp 786-831) **Executive summary of the overall developmer : plan for Phases I, III, and IV of the Ceramic Technology Readiness Program.** Dec 1979.

From Conference on advanced materials for alternate fuel capable directly fired heat engines; Castine, ME, USA (30 Jul 1979).

Two methods are being pursued to achieve higher turbine inlet temperatures. One relatively near-term approach involves the use of advanced cooling techniques with metallic nozzles and blades. While some performance penalty is incurred due to the higher cooling requirements, the net effect is a sizable performance improvement. The other approach uses ceramic materials that require little or no cooling for aerodynamic components, thus achieving the full benefit of the higher gas temperature. The development require-

ment implicit in this design means that this approach will not be available for some time. A Ceramic Technology Readiness (CTR) program, was therefore, formulated to provide convincing evidence that ceramic components can be developed that are viable for the operational requirements of utility scale gas turbines operated on coal-derived fuels. Such engines can potentially benefit the national energy situation through: higher efficiency, better tolerance of operating environment, and lower cost and higher availability. Thus, the major objective for the CTR program is to develop ceramic fabrication and design technology that will yield long-life, hot section components for advanced utilty gas turbines. These objectives are met with the High Temperature Ceramic Augmentation Turbine (HiCAT) concept which is described.

20559 (CONF-790749—, pp 866-875) **Low NO/sub x/ heavy fuel combustor program.** Bunker, W.W. (Dept. of Energy, Washington, DC). Dec 1979.

From Conference on advanced materials for alternate fuel capable directly fired heat engines; Castine, ME, USA (30 Jul 1979).

The most constructive work done to date on the Dry NO/sub x/ combustor has been conducted by EPA. The contractor for this research program was United Technologies, Inc. UTC has investigated a number of concepts the most successful of which is the staged combustor. This combustor incorporates a rich first stage, a quick quench, followed by a lean second stage. The nonstochiometric combustion minimizes the generation of thermal NO/sub x/ while the deficiency of oxygen in the rich stage minimizes the conversion of organic nitrogen to NO/sub x/. This design appears to have great merit and it will be the basic approach of the contractors in the DOE program. There are five gas turbine manufacturers who are successful contractors for Phase I of the DOE program. Each contractor will design a number of combustor configurations for testing in laboratory type burner rigs. Several types and combinations of fuel will be burned and a detailed analysis made of the test results. The results of the Phase I testing will determine the design of the Phase II combustor. Full size Phase II combustor tests will lead to the actual Phase III engine verification tests.

20560 (COO—4206-9) **Security assessment of power systems including energy storage. Progress report, April 1-June 30, 1979.** Carroll, D.P.; Triezenberg, D.M. (Purdue Univ., Lafayette, IN (USA). Energy Systems Simulation Lab.). Jul 1979. Contract EC-77-S-02-4206. 52p. Dep. NTIS, PC A04/MF A01.

A second order model of a synchronous generator was made that retains the electromechanical eigenvalues of the detailed machine model. Unfortunately, the parameters of the second order model generated depend on the machine's operating point (real and reactive power generated) as well as the external reactance connected to the machine. Therefore, a second order model with constant parameters will not retain the electromechanical eigenvalues of the machine. The variation of the parameters of the second order model with operating point and external reactance is presented graphically as the major result of this study.

20561 (DOE/ET/15428—T2) **Research and development of improved efficiency small steam turbines (IESST). Technical progress report, Phase I, 16 April-31 December 1979.** Choate, D.M.; Tuttle, A.H. (Turbodyne Corp., Wellsville, NY (USA). Steam Turbine Div.). Jan 1980. Contract AC03-79ET15428. 40p. Dep. NTIS, PC A03/MF A01.

Product Statistical Bulletins of the National Electrical Manufacturers Association (NEMA) and Turbodyne's shipment records over a 10-y period were researched to determine quantities installed and to define general parameters of design. Engineering studies were conducted to determine the optimum turbine design to meet the defined design parameters. Two conceptual designs plus an added variation of one design were completed together with designs of gearing required to provide speeds compatible with driven equipment speeds. The calculated performance of the recommended design and currently available small steam turbines were compared and a life cycle cost analysis was conducted to determine the economic competitiveness of the new design.

20562 (FE—1806-67) **Development of high-temperature turbine subsystem technology to a technology readiness status Phase II. Quarterly report, April-June 1979.** (General Electric Co., Schenectady, NY (USA). Gas Turbine Div.). 1979. Contract EX-76-C-01-1806. 207p. Dep. NTIS, PC A10/MF A01.

Progress in a program for developing a gas turbine for use in a combined-cycle power plant using coal-derived gas fuel combusted at temperature from 2600°F to 3000°F is reported. Information is included on component design and testing, system design and performance analyses, and updating the previous (Phase I) combined-cycle studies to evaluate the commercial viability of a GE-TRV turbine system. (LCL)

WASTE HEAT UTILIZATION

REFER ALSO TO CITATION(S) 20532

OFF-PEAK ENERGY STORAGE

20563 (DOE/NASA/0039—79/1) **Active heat exchange system development for latent heat thermal energy storage.** Alario, J.; Kosson, R.; Haslett, R. (Grumman Aerospace Corp., Bethpage, NY (USA)). Jan 1980. Contract EC-77-A-31-1034. 72p. (NASA-CR—159726; GAC-TR—1681-09). Dep. NTIS, PC A04/MF A01.

The selection and evaluation phase of a program to develop active heat exchange concepts for latent heat thermal energy storage systems applicable to the utility industry is described. An evaluation of suitable storage media with melting points in the temperature range of interest (250 to 400°C) limited the candidates to molten salts from the chloride, hydroxide and nitrate families, based on high storage capacity, good corrosion characteristics and availability in large quantities at reasonable cost. The specific salt recommended for laboratory tests was a chloride eutectic (20.5KCl-24.5NaCl-55.0$MgCl_2$% by wt), with a nominal melting point of 385°C. Various active heat exchange concepts were identified from among three generic categories: scrapers, agitators/vibrators and slurries. The more practical ones were given a more detailed technical evaluation and an economic comparison with a passive tube-shell design for a reference application (300 MW/sub t/ storage for 6 hours). Two concepts were selected for hardware development: a direct contact heat exchanger in which molten salt droplets are injected into a cooler counterflowing stream of liquid metal carrier fluid, and a rotating drum scraper in which molten salt is sprayed onto the circumference of a rotating drum, which contains the fluid heat sink in an internal annulus near the surface. A fixed scraper blade removes the solidified salt from the surface which has been nickel plated to decrease adhesion forces. In addition to improving performance by providing a nearly constant heat transfer rate during discharge, these active heat exchanger concepts were estimated to cost at least 25% less than the passive tube-shell design.

FUELS

REFER ALSO TO CITATION(S) 19958, 20019

20564 (CONF-790749—, pp 188-191) **Florida Power Corporation experience operating gas turbines on residual fuels.** Allen, H.L. (Florida Power Corp., St. Petersburg, FL). Dec 1979.

From Conference on advanced materials for alternate fuel capable directly fired heat engines; Castine, ME, USA (30 Jul 1979).

The major generating equipment consists of six General Electric 7000-B regenerative gas turbines with General Electric air-cooled generators. The six units were designed to deliver 311 megawatts at 95°F inlet air temperature. The heavy oil is stored on the site in two 300,000-barrel tanks. The oil is received in the raw residual tank, and then treated and stored in the second tank before it is burned in the gas turbines. A separate 50,000-barrel tank is used to store # " fuel oil for startup and shutdown of the units. Small boilers are used to heat the fuel. Most of the low sulfur and low vanadium fuels we receive have relatively high pour points; heat is required even to unload the fuel and pump it around the site. The fuel temperature must be raised to 230°F at the turbine fuel nozzles for proper burning in the gas turbine. With the properly treated and inhibited oil the turbine parts are giving excellent service. The corrosion is comparable to # 2 oil operation. Turbine deposits have been 90 to 95% water washable, and with cyclic type operation, most of the deposits come off during startup without water wash. A 185-hour continuous operation test was run to determine the effects of continuous operation. About 5% loss in output during the test was noted which could be attributed to heavy oil as a result of turbine deposits.

20565 **Recommendations and summary findings.** Washington, DC; President's Commission on Coal (Mar 1980). 26p. (NP—24388). GPO $1.75.

Throughout its term, the Commission has been keenly aware of the linkage between national security, the condition of the economy, and the Nation's dependence on imported oil. The security oof the United States and the ability to control inflation will remain compromised as long as the dangerous dependence on foreign oil continues. This is the sober reality on which the Commission's recommendation for strong governmental action to increase utility and industrial coal use is based. There are two areas of special concern. With respect to increasd coal use and protection of the environment, the differences that now exist must give way to accomodation. In labor-management relations, the distrust within and between the two sides must be put behind them. The Commission considers it essential that a process or forum be established for continued constructive accommodation of these potentially, though needlessly, competing interests. The Commission, therefore, strongly urges establishment, through the Office of the President, after consultation with representatives of all interests involved, of a White House Coal Advisory Council. The Council should consist of representatives of labor, management, and the public, to assist in and to assure implementation of the recommendations contained in this

report. The Council will provide an opportunity for management, labor, and the public to work cooperatively with government officials on matters of mutual concern that affect the ability of the Nation to strengthen its security and its economy by relying on domestic coal for a greater share of the Nation's energy requirements.

20566 Staff findings. Washington, DC; President's Commission on Coal (Mar 1980). 66p. (NP—24389). GPO $3.75.

In the 1980s, coal can contribute to the national effort to reduce oil imports by serving as a replacement fuel for oil (either alone or in coal-oil mixtures) and natural gas in electrical utility and large industrial boilers. More than 5.5 million barrels (mmbl) of oil and natural gas are consumed each day in these units. For the most part, that oil is residual oil, a byproduct of the refining process. This oil presently sells for $25 to $35 per barrel and represents a significant dollar outflow. Today, the delivered price of coal is approximately 20 to 50 percent that of oil. Because of its rapidly increasing price, much of the oil consumed in industrial and utility boilers could be replaced economically by coal, despite the substantial capital costs associated with conversion or new construction and the pollution control equipment to comply with existing Clean Air laws. Federal legislation has been in effect since 1974 to require the conversion of utility and industrial boilers to coal use. Despite this, few industrial and utility conversions have taken place. Numerous exemptions contained in the statutes (the Energy Supply and Environmental Coordination Act and the Powerplant and Industrial Fuel Use Act) have combined with a lengthy administrative procedure to tie up the conversion program in litigation and delay. The environmental effects of increased use of coal are discussed. Problems of coal mine safety, labor relations and coal miners' living conditions are evaluated.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 19996, 21053, 21141, 21150, 21240, 21241, 21243, 21350

20567 (PB—80-100027) **Socioeconomic longitudinal monitoring project. Volume I. Summary. Final report Nov 75-Jun 78.** Thompson, J.G.; Blevins, A.L. Jr.; Watts, G.L.; Kimble, R.L.; Gaarder, D. (Wyoming Univ., Laramie (USA). Center for Urban and Regional Analysis). Jun 1979. Contract OWRC-10670156. 242p. NTIS, PC A11/MF A01.

The Longitudinal Socioeconomic Monitoring Study was conducted to compare actual socioeconomic changes which accompany the construction of coal-fired electric powerplants with those projected in impact statements. Emphasis was on collecting primary data. Three surveys were conducted: (1) a household survey; (2) a business survey; and (3) a project survey. The results are summarized in five documents. Vol. I - Summary compares socioeconomic changes in McLean Co., ND and Platte Co., WY with those predicted for each county, with each other and with changes in two nonimpacted counties; Kimball Co., NE and Wheatland Co., MT. The purpose of the analysis is to estimate types and magnitudes of socioeconomic changes which occur under the condition of large scale energy development.

20568 (PB—80-100035) **Socioeconomic longitudinal monitoring project. Volume II. McLean county profile. Final report Nov 75-Jun 78.** Thompson, J.G.; Kimble, R.L.; Wisniewski, R.; Blevins, A.L. Jr.; Studer, J. (Wyoming Univ., Laramie (USA). Center for Urban and Regional Analysis). Jun 1979. Contract OWRC-10670156. 114p. NTIS, PC A06/MF A01.

The Longitudinal Socioeconomic Monitoring Study has been conducted to compare actual socioeconomic changes which accompany the construction of coal-fired electric power plants with those projected in impact statements. Volume II analyzes the socioeconomic changes in McLean County, ND which have accompanied the construction of Coal Creek Station. Of particular importance are data describing types of changes occurring in the early stages of construction and analysis of deviations from impact projections.

20569 (PB—80-100043) **Socioeconomic longitudinal monitoring project. Volume III. Platte County profile. Final report Nov 75-Jun 78.** Kimble, R.L.; Thompson, J.G.; Wisniewski, R.; Blevins, A.L. Jr.; Studer, J. (Wyoming Univ., Laramie (USA). Center for Urban and Regional Analysis). Jun 1979. Contract OWRC-10670156. 106p. NTIS, PC A06/MF A01.

The Longitudinal Socioeconomic Monitoring study has been conducted to compare actual socioeconomic changes which accompany the construction of coal-fired electric power plants with those projected in impact statements. Volume III analyzes Platte County (Wyoming), a control county for Kimball County (Nebraska). To isolate socioeconomic changes due to energy development, a control county was matched with each impacted community. The socioeconomic changes occurring in a county with little population growth are summarized in this volume.

20570 (PB—80-100050) **Socioeconomic longitudinal monitoring project. Volume IV. Wheatland County profile. Final report Nov 75-Jun 78.** Studer, J.; Wisniewski, R.; Thompson, J.G.; Kimble, R.L.; Blevins, A.L. Jr. (Wyoming Univ., Laramie (USA). Center for Urban and Regional Analysis). Jun 1979. Contract OWRC-10670156. 74p. NTIS, PC A04/MF A01.

The Longitudinal Socioeconomic Monitoring Study has been conducted to compare actual socioeconomic changes which accompany the construction of coal-fired electric generating plants with those proposed in impact statements. Vol. IV describes the Socioeconomic changes in Wheatland County (Montana) which have accompanied construction of the Laramie River Station. Significant in this volume are the descriptions of preconstruction preparations, changes in housing and employment in the year preceding construction, and mitigation arrangements for estimated impacts.

20571 (PB—80-100068) **Socioeconomic longitudinal monitoring project. Volume V. Kimball County profile. Final report Nov 75-Jun 78.** Studer, J.; Wisniewski, R.; Thompson, J.G.; Kimble, R.L.; Blevins, A.L. Jr. (Wyoming Univ., Laramie (USA). Center for Urban and Regional Analysis). Jun 1979. Contract OWRC-10670156. 77p. NTIS, PC A05/MF A01.

The Longitudinal Socioeconomic Monitoring Study has been conducted to compare actual socio-economic changes which accompany the construction of coal-fired electric power plants with those projected in impact statements. Volume V deals with Kimball County, a control county being matched with Platte County, WY. This volume analyzes social and economic changes in a county with little population growth.

20572 (PB—80-102387) **Nonwater quality impacts of closed-cycle cooling systems and the interaction of stack gas and cooling tower plumes. Final report, October 1977-January 1978.** Englesson, G.A.; Hu, M.C. (Cameron Engineers, Inc., Denver, CO (USA)). Mar 1979. Contract EPA-68-01-4337. 231p. NTIS, PC A11/MF A01.

The report gives results of a literature survey of the nonwater quality impacts of closed-cycle cooling systems. Following discussions of cooling tower and stack gas plumes, interactions of these plumes are considered. For cooling tower plumes, plume types, behavior, salt drift generation and deposition, and inadvertent weather modifications are reviewed. Meteorological conditions enhancing deposition, icing and fogging, and cloud formation are emphasized. The discussion of cooling-tower/stack-gas plume interactions focuses on interactions, acid precipitation, case studies of operating power plants, and control practices to reduce or minimize these interactions. Adverse biological impacts of acid precipitation, cooling tower drift, and icing and fogging on biota are treated. Effects of acid precipitation on soil, soil biota, vegetation, and aquatic biota (including planktonic and benthic organisms and fish) are considered relative to levels causing harm or injury. This examination includes: atmospheric and cooling tower salt loading, cumulative effects of both, and salt tolerances of animals and plants. Emphasis is on threshold concentrations at which biota is affected by drift deposition and the distance from the cooling tower where toxic levels result.

20573 Draft environmental impact statement. Electric utility steam-generating units: proposed sulfur dioxide, particulate matter, and nitrogen oxide emission standards. Research Triangle Park, NC; Environmental Protection Agency (1978). vp. (EPA—450/2-78-005a,006a,007a,a-1). Information Resources Press, 2100 M Street, NW, Suite 316, Washington, DC. (MC or HC) Order No. 79-0109. In 5 volumes.

Standards of performance are proposed for limiting emissions of sulfur dioxide, particulate matter, and nitrogen oxides from new, modified, and reconstructed electric utility steam-generating units capable of combusting more than 73 megawatts heat input (250 million British thermal units per hour) of fossil fuel. A reference method for determining continuous compliance with sulfur dioxide and nitrogen oxide standards also is proposed.

20574 Draft environmental impact statement. Sierra Pacific Power Company proposed 500-MW coal-fired generating station, North Valmy, Nevada. Reno, NV; Bureau of Land Management (1978). 392p. (DES—78-18). Information Resources Press, 2100 M Street, NW, Suite 316, Washington, DC. (MC or HC) Order No. 78-0819.

Construction of two 250-megawatt (MW) coal-fired, steam-electric-generating units in Humboldt County near Valmy, Nevada is proposed. Each generating unit would contain a coal-fired boiler, a turbine-generator unit, a baghouse for particulate control, a 500-foot stack, a mechanical draft cooling tower, and a well field for water supplies. The station also would contain a coal storage area, a coal supply and handling system, evaporation ponds for waste disposal, a landfill for ash disposal, a railroad spur, an access road, a fire protection system, a transmission system, a warehouse, and an ad-

ministration building. The power plant site would require acquisition of title to 3100 acres of land, 940 of which are federally administered.

20575 Draft environmental impact statement. Prattsville pumped storage project No. 2729, New York. Washington, DC; Federal Energy Regulatory Commission (1978). 355p. (FERC/EIS—0003). Information Resources Press, 2100 M Street, NW, Suite 316, Washington, DC. (MC or HC) Order No. 78-0939.

Construction, operation, and maintenance of the Prattsville pumped storage project No. 2729 on Schoharie Creek in Delaware, Greene, and Schoharie counties, New York are proposed by the Power Authority of the State of New York. The project would consist of: the existing 1145-acre Schoharie Reservoir, which is formed by Gilboa Dam across Schoharie Creek, a joint facility; a rolled earthfill dam which would impound a 1500-acre upper reservoir; a system of shafts and tunnels connecting the two reservoirs via the powerhouse; an underground powerhouse containing four reversible pumping-generating units with a total generating capacity of 1000 megawatts; three 345-kilovolt transmission circuits on a common right-of-way, approximately 5.6 miles in length; a haul road; and recreational facilities. The recreation plan would include a community recreation area in Prattsville, a construction overlook at the powerhouse site, a parking area for fishing access, snowmobiling, and hiking trails, a scenic overlook at Manor Kill Falls, and an educational study and picnic area.

NOXIOUS GAS AND PARTICULATE ABATEMENT AND CONTROL

REFER ALSO TO CITATION(S) 19898, 19987, 19991, 21171

20576 (FE—2205-16) **Investigation of the mechanism of fly-ash formation in coal-fired utility boilers. Quarterly report, February 1-April 30, 1979.** Ulrich, G.D. (New Hampshire Univ., Durham (USA). Dept. of Chemical Engineering). 20 Jun 1979. Contract EX-76-C-01-2205. 34p. Dep. NTIS, PC A03/MF A01.

The current status and objectives of this project are summarized. In the laboratory studies, objective A-4 has been essentially completed with the draft of the technical paper Aggregation and Growth of Submicron Oxide Particles in Flames. We are currently reviewing current literature on coagulation before rewriting the paper and submitting it for publication. The draft copy is attached to this report as Appendix A. Objective A-6, 7, the study of oxides other than silica and oxide mixtures, has just begun. Titania is the oxide under investigation. In the power plant studies, a probe, intended for use in Merrimack No. 1 and No. 2 boilers, has been designed and constructed. The probe is not water cooled, but rather depends on a refractory sheath and dilution air to keep temperatures low enough for survival of the nickel tube. Dilution air mixes with the sample at the probe tip, conveying it to the sample train. Its presence should minimize deposition of particles inside the probe. The fact that the probe is not artificially cooled should also minimize thermophoretic deposition. Original samples will be characterized by impaction and liquid fractionation of filter samples. Another aspect of plant studies is the use of nuclepore filters to fractionate samples of product ash that have been dispersed in a liquid. This is part of an effort to separate and characterize fly ash according to size and composition. The difference between this work and studies done elsewhere is the attention devoted to the submicron condensation-ash particles. Development of a model for sub-micron fly-ash formation continues. A manuscript describing this work has also been prepared and will be found in Appendix B. Separate abstracts were prepared for the two appendixes.

20577 (FE—2295-32-4A) **Medium and high temperature gas clean-up of particulates. Annual progress report, October 1977-September 1978.** (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.). Jan 1979. Contract EX-76-C-01-2295-032. 37p. Dep. NTIS, PC A03/MF A01.

The objective of the proposed research is the experimental investigation of the applicability of the EFB to the collection of particulate products of coal combustion. Bench-scale experiments are to cover the temperature range 400°F to 1800°F. In the temperature range of 400°F to 600°F, the EFB experiments are to be directed to conventional utilities combustion gas clean-up problems. In the temperature range of 400°F to 1500°F, the experiments are to be directed to fluidized bed combustion systems. Experiments in the range from 600°F to 1800°F are to be aimed at applying the EFB to the gas clean-up problems of gasifiers and combined cycle systems. From these experiments, a data base and predictive model will be evolved. The test rig has been constructed and is in operation. All instrumentation has been calibrated and is operating. High temperature impaction samplers have been adapted for the system. Testing for the first charger design is in progress and the first co-flow bed is being tested. Measurements of the V-I characteristics of dolomite for single particles and in the bed have been made and compared.

20578 (FE—2295-32-8A) **Medium and high temperature gas clean-up particulates. Annual progress report, October 1978-September 1979.** (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.). Oct 1979. Contract EX-76-C-01-2295-032. 38p. Dep. NTIS, PC A03/MF A01.

Effective corona charging and high efficiency collection in electropacked beds have been shown at temperature up to 1400°F. The search for appropriate adhesive agents for electrofluidized bed operation at high temperatures was initiated. Collection efficiency tests show that addition of borax, boric acid, or lye to the bed improves efficiency somewhat at a price of greatly increased electrical losses.

20579 (FE—5490-3) **Electrostatic granular bed filter development program. Quarterly progress report, October-December 1979.** Boericke, R.R. (General Electric Co., Schenectady, NY (USA). Energy Systems Programs Dept.). 10 Jan 1980. Contract AC01-79ET15490. 10p. Dep. NTIS, PC A02/MF A01.

This contract provides for laboratory experiments and analyses to develop electrostatic granular bed filtration for Pressurized Fluidized-Bed, combined-cycle application. These experiments will provide the data necessary to design a hot test model and to perform systems integration and economic evaluation studies. Based on the laboratory results, preliminary engineering estimates of the capital and operating costs will be provided for the selected approach. In parallel with the electrostatic granular bed filter testing, laboratory scale experiments and engineering assessments will be performed for two concepts for removing corrosive alkali metal vapors from the combustion gases. Cold model studies to identify the maximum face velocity without blowoff of bed particles are underway for particles of different size. Parametric moving bed tests have been planned.

20580 (PB—80-102379) **A technique for predicting fly ash resistivity. Final report, November 1975-May 1979.** Bickelhaupt, R.E. (Southern Research Inst., Birmingham, AL (USA)). Aug 1979. Contract EPA-68-02-2114. 115p. NTIS, PC A06/MF A01.

The report gives results of research to develop a technique for predicting: the electrical resistivity of fly ash from as-received, ultimate coal analysis; and the chemical composition of the concomitant coal ash produced by simple laboratory ignition. Important chemical factors are the alkali metals, alkaline earths, and iron (with respect to the fly ash), and the water and sulfur trioxide concentrations in the flue gas. Many fly ash samples were evaluated to minimize variations due to physical effects. The effects of fly ash chemical composition, ash layer field strength, and the water and sulfur trioxide concentrations in the test environment were evaluated with respect to electrical resistivity and the evaluated parameters for the entire temperature spectrum of interest. Equipment and techniques were developed to obtain the required data. Predicted sensitivity as a function of temperature was favorably proof-tested using data acquired from previous field evaluations of precipitators at six power generating stations. The proof test involved a comparison of predicted resistivity, laboratory measured resistivity, resistivity measured in situ, precipitator efficiency, and current density of the precipitator outlet fields.

20581 (PB—80-105828) **Definitive SOx control process evaluations: limestone, double alkali, and citrate FGD processes. Report on phase 1, January 1978-March 1979.** Tomlinson, S.V.; Kennedy, F.M.; Sudhoff, F.A.; Torstrick, R.L. (Tennessee Valley Authority, Muscle Shoals, AL (USA). Emission Control Development Projects). Aug 1979. 263p. NTIS, PC A12/MF A01.

The report gives results of a detailed comparative technical and economic evaluation of limestone slurry, generic double alkali, and citrate flue gas desulfurization (FGD) processes, assuming proven technology and using representative power plant, process design, and economic premises. For each process, economic projections were made for a base case (500 MW, 3.5% sulfur coal, new unit) and case variations in power unit size, fuel type, sulfur in fuel, new and existing power units, waste slurry ponding and filter cake trucking, and SO_2 removal (1.2 lb SO_2 allowable emission per million Btu heat input vs 90%). Depending on unit size and status, fuel type and sulfur content, solids disposal method, and overall project scope, ranges in estimated capital costs in 1979 dollars are $71 to $127/kW for limestone slurry, $80 to $130/kW for generic double alkali, and $105 to $194/kW for citrate (recovery process). Results can be scaled or altered to reflect other site-specific conditions. Capital investment, annual revenue requirements (7000 hr/yr), and lifetime revenue requirements over a 30-year declining operating profile were estimated for the base case and each variation. Investment costs were projected to mid-1979; annual revenue requirements were calculated in projected mid-1980 dollars. Effects of variations in various cost parameters were studied.

20582 (PB—298509) **Electric utility steam generating units - flue gas desulfurization capabilities as of October 1978. Final report.** Laseke, B.A. Jr; Melia, M.T.; Smith, M.T.; Koger, T.J. (PEDCO-Environmental, Inc., Cincinnati, OH (USA)). Jan 1979. Contract EPA-68-02-2811. 453p. NTIS PC A20/MF A01.

This study updates the previously published final report, 'Flue Gas Desulfurization System Capabilities for Coal-Fired Steam Generators,' EPA-600/7-78-032b published in March 1978. This assessment was made by reviewing the changes and developments in the technology since the preparation of the March 1978 report. A substantial increase in the number and capacity of operational FGD systems, plus the additional operational experience obtained by previously identified operational systems, have resulted in a substantial increase in the number and capacity of operational FGD systems, plus the additional operational experience obtained by previously identified operational systems, have resulted in a substantial increase in the amount of design and performance information. Most notably, these include dependability (availability, operability, reliability, and utilization) data, removal efficiency data (sulfur dioxide and particulate), operating problem and solution data, results from various research, development, and demonstration programs, and process and design innovations for new systems. Virtually all of the FGD operating experience gained to date has been with the wet-phase, nonregenerable, lime/limestone processes. As a direct result of this previous experience, the systems committed for operation within the next 3 to 5 years also show an overwhelming preference for lime/limestone processes. Analysis of the current status of the technology indicates that the design and operating experience gained with the first and second generation FGD systems has resulted in improved design and operation of subsequent installations. Because FGD systems that are being engineered and/or erected will incorporate many or all of these design innovations, even better performance can be expected without substantial cost increase.

20583 (PB—298510) **Electric utility steam generating units: background information for promulgated emission standards.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Jun 1979. 341p. NTIS PC A15/MF A01.

Standards of performance for the control of particulate matter, sulfur dioxide, and nitrogen oxides emissions from electric utility steam generating units have been adopted under the authority of section 111 of the Clean Air Act. These standards apply only to electric utility steam generating units capable of combusting more than 73 megawatts (250 million Btu/hr) heat input of fossil fuel and for which construction or modification began after September 18, 1978. This document contains background information, public comments, additional data collected since proposal, and EIS.

20584 (PB—299205) **Potential production and marketing of FGD byproduct sulfur and sulfuric acid in the U.S. (1983 projection). Final report, June 1976-December 1978.** O'Brien, W.E.; Anders, W.L. (Tennessee Valley Authority, Muscle Shoals, AL (USA). Emission Control Development Projects). Apr 1979. 59p. NTIS PC A04/MF A01.

The report updates to 1983 a 1978-base, computerized marketing evaluation of sulfur and H^2SO^4 as flue gas desulfurization (FGD) byproducts from U.S. coal-burning power plants. Least-costs of compliance were calculated using comparisons of clean fuel with 50 cents and 70 cents/million Btu premiums, limestone scrubbing, and scrubbing systems with byproduct sulfur and H^2SO^4 production. Market potential of sales to sulfur-burning H^2SO^4 plants was also determined. At the 50 cent premium, H^2SO^4 production was the least-cost method at five plants, four of which had combined sales of 800,000 tons/yr. At the 70 cent premium, H^2SO^4 production was the least-cost method at 26 plants, 7 of which had sales totaling 1.2 million tons. New boilers coming online by 1983 accounted for 60% of the sales. Market potential was relatively insensitive to sulfur price. Sulfur production was not selected at any plant, but reduction of total FGD costs by 3-25% would make it competitive with sulfur delivered from Port Sulphur at 16 plants with a total production of 266,000 tons. Results indicate the need of a longer time projection and continued updating of the model data bases.

20585 **Basin Electric's involvement with dry flue gas desulfurization.** Janssen, K.E.; Eriksen, R.L. (Basin Electric Power Cooperative, Bismarck, ND). pp 62-72 of Rocky Mountain Coal Mining Institute: proceedings of the 75th regular meeting. Denver, CO; Rocky Mountain Coal Mining Institute (1979).

From 75. Rocky Mountain Coal Mining Institute meeting; Vail, CO, USA (24 Jun 1979).

This report will introduce a relatively new technique of flue gas desulfurization using the dry scrubbing process. The dry scrubbing system introduces a reagent slurry, via an atomizer into the flue gas where the SO_2 is absorbed by the reagent particles. The heat from the flue gas dries the particles in the reaction chamber. The particles are then collected in an electrostatic precipitator or a baghouse and disposed of dry, eliminating the sludge dewatering process needed for the wet scrubbing systems. Several reagents have been tested with soda ash and lime yielding the most favorable results. Atomization can be accomplished by either a rotary atomizer or spray nozzle. Baghouses and precipitators are known equipment in utility plants and spray dryers are operated in thousands of chemical and industrial plants around the world. Basin Electric Power Cooperative will use the rotary atomizer and baghouse collection at the Antelope Valley Station Unit (440 MW) near Beulah, ND. The Y jet spray nozzle and precipitator collection will be used on the third unit (500 MW) of the Laramie River Station near Wheatland, WY. Reagents for both systems will be lime, due to its favorable economics over soda ash. It is estimated that the dry scrubbing system will save approximately $23 million at the Laramie River Station and $47 million at the Antelope Valley Station over the life of the plants compared to a wet scrubbing system for these site specific installations. We believe the utility industry will eventually accept the concept of dry scrubbing, not so much due to the economic factor, but because of the system's simplicity and potential high availability.

POWER TRANSMISSION AND DISTRIBUTION

20586 (EPRI-EA—1240(Vol.1)) **Initial study on the effects of transformer and transmission line noise on people. Volume 1. Annoyance. Final report.** Pearsons, K.S.; Bennett, R.L.; Fidell, S.A. (Bolt, Beranek and Newman, Inc., Canoga Park, CA (USA)). Dec 1979. 114p. Dep. NTIS, PC A06/MF A01.

The executive summary and results are presented that evaluate in a laboratory setting the relative annoyance of transmission line and transformer noise along with shaped noise and other environmental noises. Thirty-two test subjects made paired comparisons of the annoyance of 19 signals under free field listening conditions.

20587 (EPRI-EA—1240(Vol.2)) **Initial study on the effects of transformer and transmission line noise on people. Volume 2. Sleep interference. Final report.** Horonjeff, R.D.; Bennett, R.L.; Teffeteller, S.R. (Bolt, Beranek and Newman, Inc., Canoga Park, CA (USA)). Dec 1979. 68p. Dep. NTIS, PC A04/MF A01.

The relative awakening potential of four different sounds (a transformer, transmission line, window air conditioner, and distant traffic) was evaluated in a behavioral awakening study conducted in peoples' own homes. Fourteen participants in the Los Angeles, California area each participated in the experiment for a three week period. The results of the study indicate that the transformer, air conditioner, and traffic sounds would all awaken essentially the same proportion of the test population when presented at the same A-weighted sound level. The transmission line around, however, had to be presented at a level 10 dB(A) less than the other sounds to awaken an equivalent proportion of the population.

20588 (EPRI-EA—1240(Vol.3)) **Initial study on the effects of transformer and transmission line noise on people. Volume 3. Community reaction. Final report .** Fidell, S.A.; Teffeteller, S.R.; Pearsons, K.S. (Bolt, Beranek and Newman, Inc., Canoga Park, CA (USA)). Dec 1979. 61p. Dep. NTIS, PC A04/MF A01.

A social survey intended to assess reactions to exposure to noise emissions of overhead electric power transmission lines and power transformers was conducted in Southern California. A structured questionnaire similar in approach and content to a recent nationwide urban noise survey (Fidell, 1978) was administered by personal interview to a purposive sample of about 400 people residing at 17 sites along power line rights-of-way and in neighborhoods adjacent to transformer substations in urban areas. Estimates of the proportion of the American population exposed to noise of different levels from power lines and transformers were developed by analyses of several information sources. Acoustic measurements were made at all interviewing sites to assess the contributions of these low level electrical noise sources to overall background noise environments.

20589 (EPRI-EL—1250) **Development and testing of a prototype current limiting protector. Final report.** Pflanz, H.M.; Clark, T.F.; Albani, O.J. (Phoenix Electric Corp., Canton, MA (USA)). Dec 1979. 110p. Dep. NTIS, PC A06/MF A01.

A prototype pyrotechnically operated Current Limiting Protector (CLP) and a compatible high speed level sensing and trigger circuit were developed and tested. On operation in response to a short circuit a series of gaps are formed by chemical charges. The gap voltages permit commutation of the current to a parallel fusible element, which interrupts the current in a current limiting mode. The theory of the CLP was developed and confirmed with simulated dc tests and on ac tests in a high power short circuit laboratory. Prospective short circuits of 40,000 ampere (RMS sym) were limited to let-through currents of 9 to 22 kA (instantaneous), depending on the setting of the level sensing device. Some improvement of the packaging of the device and of the control circuits is required. The CLP offers economic single short current limiting protection of systems and devices, because of the low let-through current and i^2t. In addition the CLP may prove valuable as a means to extend the service life of equipment and of systems where the available short circuit has outgrown the equipment ratings.

20590 (JPL-PUBL—79-98) **Dispersed storage and generation case studies.** Bahrami, K.; Stallkamp, J.; Walton, A. (Jet Propulsion Lab., Pasadena, CA (USA)). 15 Mar 1980. Contract AI01-79ET29026. 184p. Dep. NTIS, PC A09/MF A01.

Three installations utilizing separate Dispersed Storage and Generation (DSG) technologies are selected and analyzed. These are: the 45-kW Pennsylvania Power and Light Co. Wind Turbine Generation System located at Harwood, Pennsylvania; the USAF 60-kW Photovoltaic System located at Mt. Laguna, California; and the 800-kW Applied Energy, Inc./San Diego Gas and Electric Co. Cogeneration System located at Rohr Industries, San Diego, California. Each of these systems is described in detail including connection, site construction/installation, operation, costs and control. Selected institutional and environmental issues are discussed, including life cycle costs. No unresolved technical, environmental, or institutional problems were encountered in these installations. The wind and solar photovoltaic DSG were installed for test purposes, and appear to be presently uneconomical. However, a number of factors are decreasing the cost of DSG relative to conventional alternatives, and an increased DSG penetration level may be expected in the future. Consideration should therefore be given to the issues which may be important in the future, including the control/communications requirements and regulatory issues.

AC SYSTEMS, EHV AND UHV

20591 (EPRI-EL—1246) **Development and test of a 242-kV, 4-kA heat-pipe-cooled apparatus bushing.** Arcella, F.G.; Billings, J.S. Jr.; Cushing, G.B.; Hofmann, C.F. (Westinghouse Electric Corp., Trafford, PA (USA). Power Circuit Breaker Div.). Dec 1979. 148p. Dep. NTIS, PC A07/MF A01.

The evolution of a 242-kV (900-kV BIL) 4-kA apparatus bushing that is unique in providing this rating within a below-the-flange diameter of 292 mm (11.5 in.) is described. Heat-pipe cooling of the central conductor permits operation at twice the normal current density and, nevertheless, suppresses the development of hot spots to provide an isothermal, steady-state operating mode. The insulating structure is a duplex cast-epoxy system that eliminates all use of insulating oil and cellulosics. A capacitively graded, rigid, bisphenol-epoxy composition core provides strength and low dielectric losses. A flexible, cycloaliphatic-epoxy composition weathercase is cast integral to the outer, exposed end of the core to provide excellent track resistance and weatherability. This system simplifies the structure of the bushing by eliminating such characteristic features of former designs as the oil reservoir, oil-level gauge, gasket seals, clamping springs, and oil-sampling valve. Also, the exposed epoxy weathercase is superior to porcelain in impact resistance, and provides a self-cleaning chalking action that rids itself of contaminating deposits. The design, development, and test of this bushing are discussed. The mathematics of designing the capacitively graded core is explained. Modeling of the heat pipe and the epoxy system to obtain advanced information pertinent to the design is described. With a design in hand, prototypes are built and tested electrically, mechanically, and thermally. Refinements of the design based on feedback from these tests are discussed.

20592 (EPRI-EL—1330) **Ice-release coating for disconnect switches. Final report.** Mundon, J.L. (Siemens-Allis, Inc., Portland, OR (USA)). Mar 1980. 42p. Dep. NTIS, PC A03/MF A01.

This project has shown that certain commercially available coatings, when applied to key components of air disconnect switches, reduce switch operational torque requirements under ice conditions by one half or less. Application of coated switch parts in areas subject to icing conditions would decrease switch operation requirements and provide for more reliable switch operation. The specific objectives of the project were to: (1) evaluate several coatings for ice release, heat dissipation, thermal cycling, and outdoor weathering properties, (2) apply the coating having the most desired performance in laboratory tests to full scale switch components, (3) test the full scale switches for ice performance and heat dissipation, and compare the results with those on identical switches with uncoated components. The coating chosen for application to switch components is being installed on several switches for field evaluation during the winter of 1979 and 1980. It will also be offered for commercial application for installation to new and existing switch installations. The coating also exhibited excellent heat dissipation properties and may be used to improve heat dissipation of switch blades and other components. The coating material is unaffected by sunlight; it is a two-component, Teflon-filled polyurethane that is available from two sources. The material is currently used for a variety of purposes, such as: aircraft wing and leading edge areas, hydrofoils, conveyor chutes and many others. Light gray in color, it is an excellent heat dissipator and matches the gray insulators used with most switches.

20593 (LA—8055-P) **Application of superconducting coils to VAR control in electric power systems: a proposal.** Boenig, H.J.; Hassenzahl, W.V. (Los Alamos Scientific Lab., NM (USA)). Nov 1979. Contract W-7405-ENG-36. 26p. Dep. NTIS, PC A03/MF A01.

During the last eight years, static VAR-control systems with thyristor-controlled, room-temperature reactors have been used in electrical systems for voltage control and system stabilization. In this proposal, we describe a new static VAR-control system that uses an asymmetrically controlled Graetz bridge and a superconducting dc coil. Preliminary studies indicate that the proposed system will have lower overall losses and that its capital cost and electrical characteristics are comparable to those of a conventional system. Three- and four-year programs for developing the electronic circuitry and superconducting coils for VAR control, culminating in the installation and testing of an ~ 40-MVAR system, are proposed.

SUPERCONDUCTING AND CRYOGENIC SYSTEMS

20594 (BNL—27179) **Preliminary ageing tests on a superconducting cable dilectric.** Pearmain, A.J.; Forsyth, E.B.; Kosaki, M.; Thomas, R.A. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract EY-76-C-02-0016. 4p. (CONF-800605—1). Dep. NTIS, PC A02/MF A01.

From International symposium on electrical insulation; Boston, MA, USA (9 Jun 1980).

New dielectric tapes were developed for a superconducting, flexible, ac power cable. Preliminary aging tests were performed. Tests show that the proposed system withstood frequency accelerated aging at a cable stress of 10 MV/m for an equivalent 60 Hz time period of te 531 days under the cryogenic conditions of the proposed cable. The partial discharge inception stress for a helium density of 110 kg/m^3 declined from 12.3 MV/m at the beginning of aging to 7.1 MV/m at the end. This was thought to be due to the erosion of the vapor-deposited aluminum layer on the screen tapes. Although the dielectric tapes were exposed to partial discharge activity for almost the whole period of the test, there was no significant deterioration of the tapes. This suggests that damage due to discharges must be less at cryogenic temperatures.

20595 (CONS—3015-T4) **Superconducting fault current limiter. Fourth quarterly technical progress report, May 8-July 7, 1979.** (Gould, Inc., Spring House, PA (USA)). 1979. Contract ET-78-C-01-3015. 85p. Dep. NTIS, PC A05/MF A01.

Up until now, this project has established performance objectives for the superconducting fault current limiter (SCFCL) in terms of the limitations of circuit breakers and strategies for locating the SCFCLs within the system. During this fourth quarter, the possibility has also been explored of using SCFCLs to protect specific machines, namely superconducting alternators and transformers. Unique characteristics and requirements of these machines are identified in section 2 of this report and the possible benefits to be gained by using SCFCLs are suggested. It is concluded that no further specific design work, either on the SCFCL or on the machines be done toward this goal until these superconducting devices have proved themselves further. The most promising SCFCL device is the resistive type of limiter (see the Second Quarterly Report for this project). The detailed analysis and design of this device have proceeded in the following aspects this quarter: transient circuit analysis; transient heat transfer analysis; switching field and film geometry; and shunt resistance and shunt capacitance.

NUCLEAR POWER PLANTS

REFER ALSO TO CITATION(S) 20525, 20526, 20527, 20528

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, BOILING WATER COOLED

REFER ALSO TO CITATION(S) 20635, 20636, 20661, 20662, 20666, 20672, 20673, 20674, 20675, 20676, 20680

20596 (CONF-791118—8) **Fission product release from defected LWR fuel rods.** Malinauskas, A.P.; Lorenz, R.A.; Collins, J.L. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 16p. Dep. NTIS, PC A02/MF A01.

From 7. water reactor safety research information meeting; Gaithersburg, MD, USA (5 Nov 1979).

Experiments conducted at Oak Ridge National Laboratory both with fission product simulants and with irradiated commercial fuel have been utilized to develop a semi-empirical model of fission product release from defected Light Water Reactor (LWR) fuel rods. At fuel temperatures less than 1200°C, releases occur from fission products previously accumulated in the pellet-to-cladding gap

region. In this temperature range, the release of species of moderate volatility is postulated to result from two processes. The first of these, which occurs during the period of fuel clad rupture, is due to the transport of the fill and fission product gases as they are vented through the cladding defect. The second mechanism for release, which is time-dependent, involves the diffusional transport of the semi-volatile species to the point of clad rupture through the interconnected voids (the pellet-to-cladding gap and cracks in fuel pellets) within the fuel rod.

20597 (CONF-800403—32) **Fission gas release in LWR fuel measured during nuclear operation.** Appelhans, A.D.; Skattum, E.; Osetek, D.J. (Idaho National Engineering Lab., Idaho Falls (USA)). 1980. Contract EY-76-C-07-1570. 8p. Dep. NTIS, PC A02/MF A01.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

A series of fuel behavior experiments are being conducted in the Heavy Boiling Water Reactor in Halden, Norway, to measure the release of Xe, Kr, and I fission products from typical light water reactor design fuel pellets. Helium gas is used to sweep the Xe and Kr fission gases out of two of the Instrumented Fuel Assembly 430 fuel rods and to a gamma spectrometer. The measurements of Xe and Kr are made during nuclear operation at steady state power, and for ^{135}I following reactor scram. The first experiments were conducted at a burnup of 3000 MWd/t UO_2, at bulk average fuel temperatures of ~ 850 K and ~ 23 kW/m rod power. The measured release-to-birth ratios (R/B) of Xe and Kr are of the same magnitude as those observed in small UO_2 specimen experiments, when normalized to the estimated fuel surface-to-volume ratio. Preliminary analysis indicates that the release-to-birth ratios can be calculated, using diffusion coefficients determined from small specimen data, to within a factor of ~ 2 for the IFA-430 fuel. The release rate of ^{135}I is shown to be approximately equal to that of ^{135}Xe.

20598 (CONF-800403—33) **Influence of gas pressure and composition on fuel temperature observed in the USNRC/Halden assembly IFA-430.** Miller, R.W.; Appelhans, A.D.; Dagbjartsson, S.J. (Idaho National Engineering Lab., Idaho Falls (USA)). 1980. Contract EY-76-C-07-1570. 8p. Dep. NTIS, PC A02/MF A01.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

A series of fuel behavior experiments have been conducted in the Heavy Boiling Water Reactor in Halden, Norway, to assess the effects of fuel rod internal fill gas pressure and composition on fuel temperature. Fill gases composed of He, 90% He/10% Xe, and 95% He/5% Xe at pressures from 0.1 to 5.0 MPa, were introduced into two light water reactor (LWR) design fuel rods in the Instrumented Fuel Assembly 430. These two fuel rods are connected to a gas flow system which allows the fill gases to be exchanged during nuclear operation. The two rods are identical in design except for fuel-cladding gap sizes, which are 0.1 and 0.23 mm.

20599 (PNL-SA—7746) **Progress toward acoustic emission characterization for continuous monitoring reactor pressure vessels.** Hutton, P.H.; Schwenk, E.B.; Kurtz, R.J. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1979. Contract EY-76-C-06-1830. 7p. (CONF-7909132—1). Dep. NTIS, PC A02/MF A01.

From International symposium - methods of nondestructive testing of materials and their application in nuclear engineering; Saarbrucken, F.R. Germany (17 Sep 1979).

The purpose of this work is to evaluate the feasibility of detecting and analyzing flaw growth in an operating reactor vessel using acoustic emission (AE) data. A preliminary AE-flaw growth relationship has been developed encompassing six variables. This model relates AE count and energy to fatigue crack driving force ΔK. Pattern recognition has been examined as a means of distinguishing crack growth AE from other acoustic signals with encouraging results. The program is moving into hardware implementation of relationships for testing and refinement by monitoring tests in heavy section specimens and subscale structures. The hardware system will become a reactor monitor prototype.

20600 (SAND—80-0669) **Non-linear analysis in Light Water Reactor design.** Rashid, Y.R.; Sharabi, M.N.; Nickell, R.E.; Esztergar, E.P.; Jones, J.W. (ANATECH International Corp., La Jolla, CA (USA)). Mar 1980. Contract EY-76-C-04-0789. 113p. (ALO—64; ANA—79-3). Dep. NTIS, PC A06/MF A01.

The results obtained from a scoping study sponsored by the US Department of Energy (DOE) under the Light Water Reactor (LWR) Safety Technology Program at Sandia National Laboratories are presented. Basically, this project calls for the examination of the hypothesis that the use of nonlinear analysis methods in the design of LWR systems and components of interest include such items as: the reactor vessel, vessel internals, nozzles and penetrations, component support structures, and containment structures. Piping systems are excluded because they are being addressed by a separate study. Essentially, the findings were that nonlinear analysis methods are beneficial to LWR design from a technical point of view. However, the costs needed to implement these methods are the roadblock to readily adopting them. In this sense, a cost-benefit type of analysis must be made on the various topics identified by these studies and priorities must be established. This document is the complete report by ANATECH International Corporation.

20601 (SAND—80-0826C) **Analysis of valve failure data for LWR nuclear power plants.** Schmidt, W.H. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 8p. (CONF-800403—19). Dep. NTIS, PC A02/MF A01.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

A computer analysis of the Nuclear Regulatory Commission (NRC) data file, compiled from Licensee Event Report (LER) data sheets, has been performed to characterize and highlight valve failures in light water reactor (LWR) nuclear power plants and provide guidance for valve improvement programs. The analysis is based on data from 1975 through 1978. Over this period, 889 valve citations were reported for pressurized water reactor (PWR) plants and 891 for boiling water reactor (BWR) plants. This report presents the pertinent LER data in a manner which indicates valve performance areas toward which improvement efforts may be directed.

20602 (UCLA-ENG—7974) **Determination of optimal LWR containment design, excluding accidents more severe than Class 8.** Cave, L.; Min, T.K. (California Univ., Los Angeles (USA). Dept. of Chemical, Nuclear, and Thermal Engineering). Apr 1980. Contract EY-76-C-04-0789;ET-78-S-04-5450. 249p. (ALO—68). Dep. NTIS, PC A11/MF A01.

Information is presented concerning the restrictive effect of existing NRC requirements; definition of possible targets for containment; possible containment systems for LWR; optimization of containment design for class 3 through class 8 accidents (PWR); estimated costs of some possible containment arrangements for PWR relative to the standard dry containment system; estimated costs of BWR containment.

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, NON-BOILING WATER COOLED

REFER ALSO TO CITATION(S) 20596, 20597, 20598, 20599, 20600, 20601, 20602, 20635, 20647, 20657, 20658, 20661, 20663, 20666, 20670, 20672, 20673, 20674, 20675, 20676, 20677, 20678, 20679, 21101

20603 (CONF-791103—95(Rev.)(Draft)) **Power spectral density measurements with ^{252}Cf for a light-water-moderated research reactor.** King, W.T.; Mihalczo, J.T. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 6p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

A method of determining the reactivity of far-subcritical systems from neutron noise power spectral density measurements with ^{252}Cf has previously been tested in fast reactor critical assemblies: a mockup of the Fast Flux Test Facility reactor and a uranium metal sphere. Calculations indicated that this measurement was feasible for a pressurized water reactor (PWR).

20604 (COO—4711-23) **Post-irradiation examination of Oconee 1 fuel - cycle 1 destructive test phase.** (Babcock and Wilcox Co., Lynchburg, VA (USA)). Jul 1979. Contract AC02-78ET34212. 97p. (BAW—1535). Dep. NTIS, PC A05/MF A01.

Standard B and W Mark-B (15 x 15) pressurized water reactor fuel rods were destructively examined after one cycle of irradiation in the Oconee 1 reactor. Fuel rod average burnup ranged from 10,603 to 11,270 MWd/mtU for the rods examined. Data obtained included fuel rod extraction loads, rod dimensional changes, cladding tensile properties, fuel pellet gap length, fission product distribution, fission gas and crud composition, fuel densification, chemical burnup analysis, and fuel and cladding microstructure. As expected, parametric changes were well within the design envelope. Superficial corrosion and wear were found at spacer grid contact points. However, the 19 rods examined were structurally sound and exhibited no indications of cladding defects associated with pelletcladding interactions.

20605 (UNI/SFM—3) **Planning for decommissioning of the Shippingport Atomic Power Station.** Miller, R.L. (UNC Nuclear Industries, Inc., Richland, WA (USA)). 11 Apr 1980. Contract EY-76-C-06-1857. 12p. Dep. NTIS, PC A02/MF A01.

Upon completion of defueling, Shippingport becomes the responsibility of the US Department of Energy's Surplus Facilities Management Program (SFMP) to decommission. Initial decommissioning activities will be concurrent with end-of-life testing and defueling of the reactor. The proposed government action is to dismantle Shippingport, to place the site in a radiologically safe

condition following completion of dismantling and to perform the decommissioning in such a manner so as to provide engineering, technology and cost information for future projects. The decommissioning assessment and environmental assessment are described.

POWER REACTORS, NON-BREEDING, GRAPHITE MODERATED

REFER ALSO TO CITATION(S) 20664, 20665, 20666, 20667, 20879, 20918, 20919, 20933

20606 (CONF-791103—104) **System for measuring fission-gas inventories of HTGR fuel particles.** Robbins, J.M.; Kania, M.J.; Long, E.L. Jr.; Rainey, W.T. Jr. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 18p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

A Postirradiation Gas Analyzer (PGA) has been designed and built at Oak Ridge National Laboratory for quantitatively measuring the fission- and reactive-gas inventories of irradiated High-Temperature Gas-Cooled Reactor (HTGR) fuel particles. Individual particles can be broken at ambient temperature or after heating to 2000°C, and the various gases released are quantitatively analyzed. The measure of coating integrity is determined by comparing the fission-gas inventories of the particles to their theoretical yields.

20607 (GA-A—14812(Vol.2)) **Core seismic methods verification report.** Olsen, B.E.; Shatoff, H.D.; Rakowski, J.E.; Rickard, N.D.; Thompson, R.W.; Tow, D.; Lee, T.H. (General Atomic Co., San Diego, CA (USA)). Dec 1979. Contract AT03-76ET35300. 264p. Dep. NTIS, PC A12/MF A01.

Information on HTGR reactor core seismic requirements is presented concerning element properties and code parameters; correlation and verification of the codes; sensitivity studies; and application to design.

20608 (GA-A—15840) **US/FRG Umbrella Agreement for cooperation in GCR development: Fuel, Fission Products and Graphite Subprogram. Quarterly status report, Jaunary 1, 1980-April 1, 1980.** Gulden, T.D. (General Atomic Co., San Diego, CA (USA)). Apr 1980. Contract AT03-76ET35300. 16p. Dep. NTIS, PC A02/MF A01.

Information of the HTGR cooperative program is presented concerning fuel development; fission product behavior; and graphite development.

20609 (ORNL/TM—7023) **Fission product Pd-SiC interaction in irradiated coated particle fuels.** Tiegs, T.N. (Oak Ridge National Lab., TN (USA)). Apr 1980. Contract W-7405-ENG-26. 24p. 02.

Silicon carbide is the main barrier to fission product release from coated particle fuels. Consequently, degradation of the SiC must be minimized. Electron microprobe analysis has identified that palladium causes corrosion of the SiC in irradiated coated particles. Further ceramographic and electron microprobe examinations on irradiated particles with kernels ranging in composition from UO_2 to UC_2, including PuO/sub 2 -x/ and mixed (Th, Pu) oxides, and in enrichment from 0.7 to 93.0% ^{235}U revealed that temperature is the major factor affecting the penetration rate of SiC by Pd. The effects of kernel composition, Pd concentration, other fission products, and SiC properties are secondary.

POWER REACTORS, NON-BREEDING, OTHERWISE MODERATED OR UNMODERATED

REFER ALSO TO CITATION(S) 20641

20610 (CEND—379(Vol.4)) **Conceptual design of a large HWR for US siting.** Shapiro, N.L.; Jesick, J.F. (Combustion Engineering, Inc., Windsor, CT (USA); United Engineers and Constructors, Inc., Philadelphia, PA (USA)). Sep 1979. Contract EN-77-C-01-5068. 206p. Dep. NTIS, PC A10/MF A01.

Information on PHWR type reactor is presented concerning reactors kinetics; fuel cycle charge and discharge inventory data; and capital cost.

POWER REACTORS, BREEDING

REFER ALSO TO CITATION(S) 20342, 20641, 20650, 20655, 20656, 20659, 20668, 20671, 20681, 20683, 20898, 20906, 21106, 21115

20611 (TNO-LMEC—29) **50 MW-trial circuit. Quarterly report, first quarter 1978.** (Nijverheidsorganisatie TNO, Apeldoorn-Zuid (Netherlands). Centraal Technisch Inst. TNO). [nd]. Translation of Kwartaalverslag 50 MW-beproevingscircuit le kwartaal 1978, April 1978. 7p. Dep. NTIS (US Sales Only), PC A02/MF A01.

Work performed under United States-TNO Technical Exchange Program.

During the entire period just completed the 50 MW installation has been in operation. Operations were specifically directed towards the testing program of the 85 MW-ZWT; primarily with the Na system and incidentally with the steam feedwater system.

20612 (TNO-LMEC—30) **Operation 50 MW circuit. Quarterly report, second quarter 1978.** (Nijverheidsorganisatie TNO, Apeldoorn (Netherlands)). [nd]. Translation of Kwartaalverslag 2e kwartaal 1978: exploitatie 50 MW-circuit, July 1978. 10p. Dep. NTIS (US Sales Only), PC A02/MF A01.

Work performed under United States-TNO Technical Exchange Program.

The operational shutdown which had already started in the previous reporting period continued during this period. Full continuous service was resumed on March 13 and a start has been made on a program of pre-operational tests anticipating the completion of putting the system into service including the 85 MW-ZWT.

20613 (CONF-791103—99) **Development of the Centralized Reliability Data Organization (CREDO).** Haas, P.M.; Bott, T.F.; Knee, H.E.; Manning, J.J.; Hudson, S.D.; Greene, N.M.; Woodside, M.A. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 7p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

CREDO has been established to meet the needs of the US Breeder Reactor Program and the advanced reactor community for a centralized source of accurate reliability/maintainability data and data-related services. The center provides for a comprehensive program of collection, evaluation, and dissemination of data and for necessary user services. A steering committee of nationally recognized experts has been formed to guide CREDO development and operation. Historic data have been collected, analyzed, and published. Routine, continuous data collection and processing has been initiated at US sites. Interfaces with existing data bases have been established. Special user services are under development.

20614 (CONF-800607—29) **Blanket design considerations for fast reactor oxide fuel systems based on CRBRP experience.** Garkisch, H.D. (Westinghouse Electric Corp., Madison, PA (USA). Advanced Reactors Div.). 1980. Contract AC15-76CL02395. 6p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society annual meeting; Las Vegas, NV, USA (8 Jun 1980).

The blanket assemblies are of prime importance in achieving the performance goals of fast reactor fuel systems to conserve uranium ore and to minimize fuel cycle costs. The purpose of past blanket design efforts in the US was to meet these goals with designs of optimum fuel and thermal performance. Only the Clinch River Breeder Reactor Plant (CRBRP) blanket design has evolved beyond the conceptual stage. The CRBRP blanket assembly design is based on conservatively predicted environments and criteria which are being confirmed by a design oriented development program. The results of the ongoing program obtained to date have not indicated any need for assembly design changes. However, since the irradiation testing of blanket rods is not completed, the ultimate performance capability of the blanket is presently not known. Therefore, conservative blanket assembly design criteria and predicted environments must be utilized for performance predictions at the present time.

20615 (GA—10298(Amend.9)) **Gas-Cooled Fast Breeder Reactor preliminary safety information document, Amendment 9. GCFR fuel cladding PC-5 (faulted) temperature limit.** (General Atomic Co., San Diego, CA (USA)). 1 Feb 1980. Contract AT03-76SF71023. 113p. Dep. NTIS, PC A06/MF A01.

Information is presented concerning GCFR design and limiting faulted events; selection of PC-5 temperature limit; and verification test programs.

20616 (GEFR-SP—172) **Carbon transport in a bimetallic sodium loop simulating the intermediate heat transport system of a liquid metal fast breeder reactor.** Hampton, L.V.; Spalaris, C.N.; Roy, P. (General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.). Apr 1980. Contract EY-76-C-03-0893-031. 20p. (CONF-800401—7). Dep. NTIS, PC A02/MF A01.

From 2. international conference of liquid metal technology for energy systems; Richland, WA, USA (20 Apr 1980).

Carbon transport data from a bimetallic sodium loop simulating the intermediate heat transport system of a Liquid Metal Fast Breeder Reactor are discussed. The results of bulk carbon analyses after 15,000 hours' exposure indicate a pattern of carburization of

Type 304 stainless steel foils which is independent of loop sodium temperature. A model based on carbon activity gradients accounting for this behavior is proposed. Data also indicate that carburization of Type 304 stainless steel is a diffusion-controlled process; however, decarburization of the ferritic 2 1/4 Cr-1Mo steel is not. It is proposed that the decarburization of the ferritic steel is controlled by the dissolution of carbides in the steel matrix. The differences in the sodium decarburization behavior of electroslag remelted and vacuum-arc remelted 2 1/4 Cr-1Mo steel are also highlighted.

20617 (GEFR-SP—210) **Background noise measurements on prototype of SNR 300 steam generator at Hengelo.** Greene, D.A.; Meyer, G.J.A.M.; Ahlgren, F.F.; Van Westerbrugge, J.K. (General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.). 1980. Contract EY-76-C-03-0893-031. 10p. (CONF-800401—2). Dep. NTIS, PC A02/MF A01.

From 2. international conference of liquid metal technology for energy systems; Richland, WA, USA (20 Apr 1980).

Acoustic noise amplitudes were measured in a 50 MW helical coil prototype of a steam generator mounted in the Hengelo test facility in a joint technical program betwen GE/DOE and TNO/NERATOOM. Background noise measurements were completed with test conditions ranging from quiescent (with no sodium or water flow) to high thermal power transfer from the sodium circuit to the water circuit. The acoustic noise pressure on the vessel wall was measured using externally mounted accelerometers. Data were obtained for the effect of sodium flow rate on the acoustic noise amplitude. A preliminary correlation was derived for the acoustic noise generated by nucleate boiling. Leak detection and location were demonstrated.

20618 (GEFR-SP—212) **Acoustic leak detection/location system for sodium heated steam generators.** Greene, D.A.; Meneely, D.; Ahlgren, F.F. (General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.). 1980. Contract EY-76-C-03-0893-031. 12p. (CONF-800401—3). Dep. NTIS, PC A02/MF A01.

From 2. international conference of liquid metal technology for energy systems; Richland, WA, USA (20 Apr 1980).

The design of an acoustic leak detection system to monitor for sodium-water reactions in a LMFBR steam generator is described. The detector is based on similar techniques to passive SONAR. It relies on the only absolute parameters associated with a sodium-water reaction: the leak is stationary in space and generates noise. By forming an array from externally mounted sensors and using statistical processing techniques, signals masked by the general background noise can be recovered. Supporting experimental and analytical investigations are also described. Predictions are made of the detection sensitivity of an acoustic leak detection system for an LMFBR.

20619 (GEFR-SP—213) **Leak location in a double wall tube steam generator.** Greene, D.A.; McMurtrie, K.R.; Gaubatz, D.C. (General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.). 1980. Contract EY-76-C-03-0893-031. 8p. (CONF-800401—4). Dep. NTIS, PC A02/MF A01.

From 2. international conference of liquid metal technology for energy systems; Richland, WA, USA (20 Apr 1980).

An experimental and analytical study was made of an acoustic location system for use with double wall tube steam generators. A conceptual design of an acoustic leak location system was developed. This system has the potential for detecting the third fluid gas escaping from the annulus between the double walled tubes into the sodium. The acoustic system uses an array of accelerometers mounted onto the outside of the steam generator vessel. Electronic circuitry selects a number of accelerometers, forms them into an array which focuses within the vessel. The volume of the vessel is sequentially scanned for anomalous acoustic energy.

20620 (KFK—2797) **On-line gamma spectroscopy measuring station for cover gas monitoring at KNK II.** Hoffmann, G.; Letz, K.D. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung). Feb 1980. 128p. Dep. NTIS (US Sales Only), PC A07/MF A01.

An automated gamma spectrometer was developed for cover gas monitoring at KNK II, which, by the gamma spectra measured, is to allow the following statements to be made on fuel cladding failure: type, size, variation with time, and subsequent development of the failure. The hardware and software are explained. Besides, an instruction manual was written for the measuring station, which allows to operate it without detailed knowledge of the manuals for the individual hardware components.

20621 (KFK—2837) **Heat transfer and friction coefficients for air flow in a smooth annulus. Results of a recent experiment and comparison with previous correlations.** Dalle Donne, M.; Meyer, L. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik). 1978. 23p. (EUR—5758e). Dep. NTIS (US Sales Only), PC A02/MF A01.

Work performed under United States-W. Germany Fast Reactor Exchange Program.

In the Heat Transfer Laboratory of INR various experiments on single rough or smooth rods contained in smooth annuli have been performed in the past. These experiments have been performed with rods of large diameters. Recently however a series of experiments with rough rods of 8 mm O.D. has been carried out. To check if the new experimental apparatus and the experimental techniques used were correct, an experiment was performed with an inner heated tube of 8 mm O.D. contained in the smooth outer tube of 16 mm I.D. used in the experiments with the rough rods. The results of this experiment are reported. The friction and heat transfer data obtained with the turbulent flow runs of the present experiment agree well with previous experiments performed at INR with larger smooth annuli.

20622 (LA—8292-MS) **Effect of model choice and sample size on statistical tolerance limits.** Duran, B.S.; Campbell, K. (Los Alamos Scientific Lab., NM (USA)). Mar 1980. Contract W-7405-ENG-36. 50p. Dep. NTIS, PC A03/MF A01.

Statistical tolerance limits are estimates of large (or small) quantiles of a distribution, quantities which are very sensitive to the shape of the tail of the distribution. The exact nature of this tail behavior cannot be ascertained brom small samples, so statistical tolerance limits are frequently computed using a statistical model chosen on the basis of theoretical considerations or prior experience with similar populations. This report illustrates the effects of such choices on the computations.

20623 (WAPD-TM—1253) **Summary of several hydraulic tests in support of the light water breeder reactor design (LWBR development program).** McWilliams, K.D.; Turner, J.R. (Bettis Atomic Power Lab., West Mifflin, PA (USA)). May 1979. Contract AC11-76PN00014. 142p. Dep. NTIS, PC A07/MF A01.

As part of the Light Water Breeder Reactor development program, hydraulic tests of reactor components were performed. This report presents the results of several of those tests performed for components which are somewhat unique in their application to a pressurized water reactor design. The components tested include: triplate orifices used for flow distribution purposes, multiventuri type flowmeters, tight lattice triangular pitch rod support grids, fuel rod end support plates, and the balance piston which is a major component of the movable fuel balancing system. Test results include component pressure loss coefficients, flowmeter coefficients and fuel rod region pressure drop characteristics.

20624 (WAPD-TM—1369) **Model for incorporating fuel swelling and clad shrinkage effects in diffusion theory calculations (LWBR Development Program).** Schick, W.C. Jr.; Milani, S.; Duncombe, E. (Bettis Atomic Power Lab., West Mifflin, PA (USA)). Mar 1980. Contract AC11-76PN00014. 56p. Dep. NTIS, PC A04/MF A01.

A model has been devised for incorporating into the thermal feedback procedure of the PDQ few-group diffusion theory computer program the explicit calculation of depletion and temperature dependent fuel-rod shrinkage and swelling at each mesh point. The model determines the effect on reactivity of the change in hydrogen concentration caused by the variation in coolant channel area as the rods contract and expand. The calculation of fuel temperature, and hence of Doppler-broadened cross sections, is improved by correcting the heat transfer coefficient of the fuel-clad gap for the effects of clad creep, fuel densification and swelling, and release of fission-product gases into the gap. An approximate calculation of clad stress is also included in the model.

20625 (WAPD-TM—1383) **ACCEPT: a three-dimensional finite element program for large deformation elastic-plastic-creep analysis of pressurized tubes (LWBR/AWBA Development Program).** Hutula, D.N.; Wiancko, B.E. (Bettis Atomic Power Lab., West Mifflin, PA (USA)). Mar 1980. Contract AC11-76PN00014. 135p. Dep. NTIS, PC A07/MF A01.

ACCEPT is a three-dimensional finite element computer program for analysis of large-deformation elastic-plastic-creep response of Zircaloy tubes subjected to temperature, surface pressures, and axial force. A twenty-mode, tri-quadratic, isoparametric element is used along with a Zircaloy materials model. A linear time-incremental procedure with residual force correction is used to solve for the time-dependent response. The program features an algorithm which automatically chooses the time step sizes to control the accuracy and numerical stability of the solution. A contact-separation capability allows modeling of interaction of reactor fuel rod cladding with fuel pellets or external supports.

20626 **Annular linear induction pump with an externally supported duct.** Craig, E.R.; Semken, R.S. (to Dept. of Energy). US Patent 4,174,190. 13 Nov 1979. Filed date 30 Jun 1977. 8p.

PAT-APPL-811,627.

Several embodiments of an annular linear induction pump for pumping liquid metals are disclosed having the features of generally one pass flow of the liquid metal through the pump and an increased

efficiency resulting from the use of thin duct walls to enclose the stator. The stator components of this pump are removable for repair and replacement. 15 claims.

20627 Instantaneous fuel growth rates for breeder reactors. Maudlin, P.J.; Ott, K.O.; Borg, R.C. (Purdue Univ., West Lafayette, IN). *Nucl. Sci. Eng.;* 72: No. 2, 140-151(Nov 1979).

Breeding estimates for long-term reactor fuel logistics are pursued, specifically deriving as instantaneous or transitory fuel growth rate definition $\gamma(t)$, from the basic space- and time-dependent fuel cycle equations. The derivation is valid for either the discontinuous or continuous fuel cycle treatments. The resulting definition is applied to a uranium-plutonium fast reactor operating in the closed fuel cycle mode. Transitory growth rate results are calculated for various fuel isotopic weight-factor sets and initial fuel compositions. These results show $\gamma(t)$ to be practically independent of the isotopic weight-factor sets, provided the $\gamma(t)$ is calculated from the time-dependent variation of the fuel isotopes. The growth rate derivation automatically yields the fuel composition shift in the form of the reactor fuel time derivative. Investigations of the impact of this quantity on transitory breeding descriptions show that it is the erroneous neglect of the fuel composition-shift term that induces the previously observed strong dependence of the growth rate upon the fuel isotopic weight-factor sets. Accurate approximation of the instantaneous fuel growth rate using transitory static reaction rate information (fuel-shift term neglected) is shown possible with the substitutional critical mass (CM) worth weights, w/sub i//sup CM/.

20628 Description of reactor fuel breeding with three integral concepts. Ott, K.O.; Hanan, N.A.; Maudlin, P.J.; Borg, R.C. (Purdue Univ., West Lafayette, IN). *Nucl. Sci. Eng.;* 72: No. 2, 152-159(Nov 1979).

The time-dependent breeding of fuel in a growing system of breeder reactors can be characterized by the transitory (instantaneous) growth rate, $\gamma(t)$. The three most important aspects of $\gamma(t)$ can be expressed by time-independent integral concepts. Two of these concepts are in widespread use. A third integral concept that links the two earlier ones is introduced. The time-dependent growth rate has an asymptotic value, $\gamma/\sup \text{infinity}/$, the equilibrium growth rate, which is the basis for the calculation of the doubling time. The equilibrium growth rate measures the breeding capability and represents a reactor property. Maximum deviation of $\gamma(t)$ and $\gamma/\sup \text{infinity}/$ generally appears at the initial startup of the reactor, where $\gamma(t = 0) = \gamma_0$. This deviation is due to the difference between the initial and asymptotic fuel inventory composition. The initial growth rate can be considered a second integral concept; it characterizes the breeding of a particular fuel in a given reactor. Growth rates are logarithmic derivatives of the growing mass of fuel in breeder reactors, especially $\gamma/\sup \text{infinity}/$, which describes the asymptotic growth by $\exp(\gamma/\sup \text{infinity}/t)$. There is, however, a variation in the fuel-mass factor in front of this exponential function during the transition from γ_0 to $\gamma/\sup \text{infinity}/$. It is shown that this variation of the fuel mass during transitioncan be described by a third integral concept, termed the breeding bonus, b. The breeding bonus measures the quality of a fuel for its use in a given reactor in terms of its impact on the magnitude of the asymptotically growing fuel mass. The calculation of γ_0 and $\gamma/\sup \text{infinity}/$ is facilitated by use of the critical mass (CM) worths (w/sub i//sup CM/) and the breeding worth factors (w/sub i//sup */), respectively. It is shown here that the calculation of the breeding bonus, as a quantity that links initial and asymptotic fuel growth, is based on the joint application of w/sub i//sup CM/ and w/sub i//sup */.

20629 (DOE-tr—126) **Turbulent flow in a wall channel of a rod bundle.** Rehme, K. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik). Sep 1979. Translation of KFK—2617, April 1978. 93p. Dep. NTIS (US Sales Only), PC A05/MF A01.

Work performed under United States-W. Germany Fast Reactor Exchange Program.

The turbulent flow through a wall subchannel of a rod bundle was investigated experimentally by means of hot-wires and Pitot-tubes. The aim of this investigation was to get experimental information on the transport properties of turbulent flow especially on the momentum transport. Detailed data were measured of the distributions of the time-mean velocity, the turbulence intensities and, hence the kinetic of turbulence, of the shear stresses in the directions normal and parallel to the walls, and of the wall shear stresses. The pitch-to-diameter ratio of the rods equal to the wall-to-diameter ratio was 1.15, the Reynolds number of this investigation was $Re = 1.23 \cdot 10^5$. On the basis of the measurements the eddy viscosities normal and parallel to the walls were calculated.

20630 (DOE-tr—142) **Possibilities for the determination of the heat transfer process between nuclear fuel rods and the cooling medium in a sodium-cooled reactor during operation.** Mitzel, F. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik). Aug 1979. Translation of KFK—2619, June 1978. 52p. Dep. NTIS (US Sales Only), PC A04/MF A01.

Work performed under United States-W. Germany Fast Reactor Exchange Program.

In order to improve the safety, the surveillance and economy of sodium cooled reactors it is desirable to obtain a more precise knowledge of the heat transfer between the fuel and the coolant. Different possibilities have been investigated to determine the corresponding heat transfer coefficient by measuring the pertinent transfer functions. The result was the following: the heat transfer coefficient can be determined with reasonable accuracy at the KNK II and the SNR by means of small pseudo-stochastic power oscillations. These power oscillations must be artificially induced but do not require an interruption of the normal plant operation.

20631 Fast breeder reactor blanket management: comparison of LMFBR and GCFR blankets. Jankhah, M.H. Rolla, MI; Univ. of Missouri (1978). 162p. University Microfilms Order No. 78-22,375. Thesis (Ph. D.).

The economic performance of the fast breeder reactor blanket, considering different fuel management schemes was studied. To perform this, the investigation started with a standard reactor physics calculation. Then, two economic models for evaluation of the economic performance of the radial blanket were developed. These models formed the basis of a computer code, ECOBLAN, which computes the net economic gain and the levelized fuel cost due to the radial blanket. The net gain in terms of dollars and $/kgHM-y and the levelized fuel cost in mills/kWhe were obtained as a function of blanket thickness and a residence time of the fuel in the blanket. A LMFBR and a GCFR were the reactor models considered in this study. The optimum radial blanket of a GCFR consists of two rows, that of a LMFBR consists of three rows. Regarding the different fuel management schemes, the fixed blanket was found to be more favorable than reshuffled blanket. Out-in and in-out reshuffled blanket offer almost the same net gain. In all the cases, the burnup calculated for the fuel was found to be less than the acceptable limit. There is an optimum residence time for the fuel in the blanket which depends on the position of the fuel in the blanket and the fuel management scheme studied. As expected, except for very short residence times (less than 2.5 years), the radial blanket is a net income producer. There is no significant difference between the economic performance of the blanket of a LMFBR and a GCFR.

POWER REACTORS, AUXILIARY, MOBILE, PACKAGE, AND TRANSPORTABLE

REFER ALSO TO CITATION(S) 20641

REGULATION AND LICENSING

20632 (RDT-INDEX—(4-80)) **RDT Standards index.** (Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs). Apr 1980. Contract W-7405-ENG-26. 38p. RSO.

The April 1980 Index of RDT Standards is presented. This issue covers January through March 1980. The attached New Publications List identifies each standard, amendment, and/or revision that was published during this period.

20633 (RDT-STATUS—(4-80)) **RDT Standards status report.** (Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs). Apr 1980. Contract W-7405-ENG-26. 34p. RSO.

The April 1980 Status Report of RDT Standards is presented. This issue covers January through March 1980. See the April 1980 Index of RDT Standards for published standards that do not appear in this report. The next issue of the Status Report will be available in July 1980.

ECONOMICS

20634 Computerized cost control of nuclear power plants. Halpin, D.W. (Ga Inst of Technol, Atlanta). *J. Constr. Div., Proc. ASCE;* **105**: No. 4, 305-315(Dec 1979).

As part of a Department of Energy funded project entitled "Information Management for Nuclear Power Stations", a survey of existing cost control systems was conducted. Based on this study, a model for collecting and evaluating cost information using the physical layout or configuration of the plant was developed. This paper presents an overview of some of the systems presently used and introduces the cost structure of the Project Configuration Model (PCM).

CONSTRUCTION AND OPERATION

20635 (R—2504-RC) **Second cost analysis of light water reactor power plants.** Mooz, W.E. (RAND Corp., Santa Monica, CA (USA)). Dec 1979. 63p. Rand, Santa Monica, CA.

This report is an update of a Rand study made in 1978. The earlier effort analyzed statistically the construction permit time, construction time, and capital costs of all light water reactor (LWR) power plants in the United States for which data were then available. One of its major findings was that capital costs were increasing at the rate of $158 per kWe per year (1978 dollars), and that there were no signs of this rapid increase leveling off. From the standpoint of energy policy, this finding had alarming implications. Since the time of the first study, many more data have become available. This report examines the new data base for the light it can throw on the issues involved, for a deeper understanding of what is happening with capital costs, and for confirmation of the results of the previous study. The results should help policymakers, utility planners, and energy analysts attempting to discern cost differences among options.

FUEL CYCLE

20636 (GA-A—15734) **Dresden 1 plutonium recycle program. Final report.** Bresnick, S.D. (General Atomic Co., San Diego, CA (USA)). Jan 1980. Contract EY-76-C-02-2210. 71p. Dep. NTIS, PC A04/MF A01.

This is the final report on the Dresden 1 Plutonium Recycle Demonstration Program. It covers the work performed from July 1, 1978 to completion, which includes in-pool inspection of two fuel assemblies, removal of two fuel rods, and post-irradiation examination (PIE) of six fuel rods. Appendix A describes the inspection and rod removal operations, and Appendix B describes the PIE work.

20637 (ORNL/TM—7215) **Economic data base for alternative nuclear fuel cycle evaluations for US electrical utility industry conditions.** Delene, J.G.; Bowers, H.I. (comps.). (Oak Ridge National Lab., TN (USA)). Apr 1980. Contract W-7405-ENG-26. 33p. Dep. NTIS, PC A03/MF A01.

The evaluated economic data base used in the Nonproliferation Alternative Systems Assessment Program (NASAP) is presented. This data base contains information needed to evaluate alternative nuclear fuel cycles. This information includes unit cost estimates for the nuclear fuel cycle, capital investment and operation and maintenance costs, money costs and financial parameters, heavy-water costs, projections of US nuclear capacities, and key dates for alternative reactor/fuel system deployment. The sources of the data, tabulated in 15 tables, are discussed.

NUCLEAR REACTOR TECHNOLOGY

THEORY AND CALCULATION

REFER ALSO TO CITATION(S) 20652

20638 (CONF-791103—80) **Application of depletion perturbation theory to fuel cycle burnup analysis.** White, J.R. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 7p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

Over the past several years static perturbation theory methods have been increasingly used for reactor analysis in lieu of more detailed and costly direct computations. Recently, perturbation methods incorporating time dependence have also received attention, and several authors have demonstrated their applicability to fuel burnup analysis. The objective of the work described here is to demonstrate that a time-dependent perturbation method can be easily and accurately applied to realistic depletion problems.

20639 (CONF-791103—97) **Computation of analytical bounds for cross section self-shielding factors.** Barhen, J.; Cacuci, D.G. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 7p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

The shielding factor method (SFM) is a frequently used economical procedure for computing the effective multigroup cross sections needed in reactor analysis. While initially developed and employed in codes used by the fast reactor community, the method has been receiving increased attention in recent years from the electric utility industry, for applications to power reactors. A fundamental problem regarding the method's applicability is to determine the limits of the range of values within which a cross section shielding factor is restricted, and whether these limits are physically meaningful. In a previous paper strict upper and lower bounds for the transport f-factor and for the sum of reaction f-factors were derived and discussed. The purpose of the present work is to present extensions of the methodology used for the upper and lower bounds of the transport f-factor and reaction f-factors.

20640 (INDC(NDS)—103/M, pp 50-58) **Summary remarks and recommended reactions for an international data file for dosimetry applications for LWR, FBR, and MFR reactor research, development and testing programs.** McElroy, W.N.; Lippincott, E.P. (Hanford Engineering Development Lab., Richland, WA (USA)); Grundl, J.A. (National Bureau of Standards, Washington, DC (USA)); Fabry, A. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)); Dierckx, R. (Commission of the European Communities, Ispra (Italy). Joint Research Centre); Farinelli, U. (Comitato Nazionale per l'Energia Nucleare, Casaccia (Italy). Centro di Studi Nucleari). May 1979.

In Proceedings of the advisory group meeting on nuclear data for reactor dosimetry, Vienna, 13-17 November 1978.

The need for the use of an internationally accepted data file for dosimetry applications for light water reactor (LWR), fast breeder reactor (FBR), and magnetic fusion reactor (MFR) research, development, and testing programs continues to exist for the nuclear industry. The work of this IAEA meeting, therefore, is another important step in achieving consensus agreement on an internationally recommended file and its purpose, content, structure, selected reactions, and associated uncertainty files. Summary remarks and a listing of recommended reactions for consideration in the formulation of an "International Data File for Dosimetry Applications" are presented in subsequent sections of this report.

20641 (LA—8259-PR) **Reactor technology. Progress report, October-December 1979.** Emigh, C.R. (Los Alamos Scientific Lab., NM (USA)). Mar 1980. Contract W-7405-ENG-36. 142p. Dep. NTIS, PC A07/MF A01.

Significant progress is reported in the Space Reactor (SPAR) Electric Power Supply Program with the receipt of 2-D control rod calculations computing a reactivity worth of 7% available from natural B_4C, and 12.5% from 90%-enriched B_4C. The current 5% reactivity requirement is easily met. Molybdenum/sodium heat pipes SPAR-2 and SPAR-2A were completed and will be used in thermoelectric module development. The Heat Pipe Technology Development Program continues its investigation of improved ceramic heat pipe materials and closure configurations and their effect on material interface stresses. The Gas-Cooled Fast Reactor Safety Experiments Program reports the FLS3 test system configuration evolving as a result of continuing LASL and GA cooperation. Agreement was reached with GA that the system operating pressure will not exceed 6.6 MPa because of the limitation imposed by the thin wall of the available heat exchanger. Activity in the Reactor Safety/Structural Analysis Program continued with the core support block thermal stress analyses, heavy-water reactor seismic analysis, and analysis of prestressed concrete reactor vessels. Nuclear Criticality Experiments and Safety reports experiments are being prepared to evaluate the use of fast-neutron hodoscope technology to study the fission distribution in dynamic subcritical assemblies. The use of the Skua assembly to simulate reactor core meltdown conditions is being investigated.

COMPONENTS AND ACCESSORIES

REFER ALSO TO CITATION(S) 20892, 20893, 20910, 20911, 20913, 20935, 21104

20642 (CONF-791051—21) **Neutron spectral characterization of the NRC-HSST experiments.** Stallmann, F.W.; Kam, F.B.K. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 19p. Dep. NTIS, PC A02/MF A01.

From 3. ASTM-EURATOM symposium on reactor dosimetry; Ispra, Italy (1 Oct 1979).

Irradiation experiments are being performed for the US Nuclear Regulatory Commission (NRC) Heavy Section Steel Technology (HSST) program. Results of dosimetry performed in the second experiment have been previously reported. Similar procedures were followed in the third experiment. The experiences gained in these two experiments have led to modifications in the composition and distribution of foil dosimeters which monitor the neutron flux-spectra in the irradiated steel specimens. It is expected that in the new experiments much higher accuracies than previously possible can be achieved in the determination of irradiation damage parameters.

20643 (CONF-791103—77) **Nuclear heating in thick iron slabs at the ORR Pool Side Facility.** Siman-Tov, I.I. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 5p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

The purpose of this work was to determine experimentally and computationally the nuclear heating rates in iron in the Pool Side Facility (PSF) of the Oak Ridge Research Reactor (ORR). This work was performed in support of the NRC-Pressure Vessel Surveillance Program, the objective of which is to verify and upgrade dosimetry and damage correlations for pressure vessels of Light Water Reactors (LWR).

20644 (RDT-E—8-18T(Ammend.)) **Threaded fasteners for nuclear components.** (Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs). Jul 1979. Contract W-7405-ENG-26. 5p. RSO.

Materials for nuts in the form of hollow bars or forgings shall be examined circumferentially by the angle beam method in accordance with SA-388, Article 23, ASME Code, Section V. Nuts made from shaped (nonround) stock shall be examined circumferentially by the angle beam method at the latest stage possible for meaningful results (but prior to threading).

CONTROL SYSTEMS

20645 (CONF-800403—34) **LOFT Augmented Operator Capability Program.** Hollenbeck, D.A.; Krantz, E.A.; Hunt, G.L.; Meyer, O.R. (EG and G Idaho, Inc., Idaho Falls (USA)). 1980. Contract EY-76-C-07-1570. 8p. Dep. NTIS, PC A02/MF A01.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

The outline of the LOFT Augmented Operator Capability Program is presented. This program utilizes the LOFT (Loss-of-Fluid Test) reactor facility which is located at the Idaho National Engineering Laboratory and the LOFT operational transient experiment series as a test bed for methods of enhancing the reactor operator's capability for safer operation. The design of an Operational Diagnotics and Display System is presented which was backfit to the existing data acquisition computers. Basic color-graphic displays of the process schematic and trend type are presented. In addition, displays were developed and are presented which represent safety state vector information. A task analysis method was applied to LOFT reactor operating procedures to test its usefulness in defining the operator's information needs and workload.

ENVIRONMENTAL ASPECTS

SITING

20646 **Siting policy for an acceptable nuclear future.** Burwell, C.C. (Inst. for Energy Analysis, Oak Ridge, TN); Ohanian, M.J.; Weinberg, A.M. *Science;* **204**: 1043-1051(8 Jun 1979).

This article is an outgrowth of studies aimed at devising an acceptable nuclear energy system for the United States. It is argued that a nuclear siting policy leading to a few, large concentrated sites is preferable in the long run to the present policy which could lead to many dispersed sites. Such a policy could be implemented incrementally if requirements for new nuclear generating capacity were met by adding reactors to the existing 100-odd sites. Such a concentrated nuclear siting policy would, to some extent, isolate nuclear activities while augmenting the strengths of the institutions responsible for managing them. Additionally, it would confer an element of permanence on the sites and thereby open new options for managing low level wastes and reactor decommissioning. These actions may improve the public acceptability of nuclear energy in the United States as well as lead to a more rational contained nuclear system in the long run. 3 figures, 3 tables. (DP)

RADIOACTIVE EFFLUENTS

20647 (CONF-800607—9) **Measured performance of four PWR liquid radioactive waste treatment systems.** McIsaac, C.V.; Mandler, J.W.; Stalker, A.C. (EG and G Idaho, Inc., Idaho Falls (USA)). 1980. Contract EY-76-C-07-1570. 6p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society annual meeting; Las Vegas, NV, USA (8 Jun 1980).

This paper presents results of a study of the liquid radwaste treatment and boron recovery systems of four operating PWR power plants. The performance of a given system was determined from measurements of radionuclide inventories in samples drawn from demineralizers, evaporators, filters, and gaseous cleanup systems. The plants at which measurements were made are Fort Calhoun, Zion 1 and 2, Turkey Point 3 and 4, and Rancho Seco.

CHEMICAL AND THERMAL EFFLUENTS

REFER ALSO TO CITATION(S) 21204, 21333, 21334

RESEARCH, TEST, AND EXPERIMENTAL REACTORS

REFER ALSO TO CITATION(S) 20603, 20642, 20645, 20656, 20658, 20669, 20670

20648 (CONF-791103—76) **Test bed for high-uranium-loaded fuel plates.** Senn, R.L.; Martin, M.M. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 3p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

An irradiation test facility has been designed and built to provide a test bed for irradiating a variety of miniature fuel plates. The objective of these tests is to screen various candidate materials as to their suitability for replacing the fully enriched uranium fuel materials currently used by the world's test and research reactors with a lower enrichment fuel material, without significantly degrading reactor operating characteristics and power levels. The use of low-uranium enrichment (up to 45%) in place of highly-enriched fuel for these reactors would reduce the potential for ^{235}U diversion.

20649 (CONF-791103—95) **Power spectral density measurements with ^{252}Cf for a light water moderated research reactor.** King, W.T.; Mihalczo, J.T. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 5p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

A method of determining the reactivity of far subcritical systems from neutron noise power spectral density measurements with ^{252}Cf has previously been tested in fast reactor critical assemblies: a mockup of the Fast Flux Test Facility reactor and a uranium metal sphere. Calculations indicated that this measurement was feasible for a pressurized water reactor (PWR). In order to evaluate the ability to perform these measurements with moderated reactors which have long prompt neutron lifetimes, measurements were performed with a small plate-type research reactor whose neutron lifetime (57 microseconds) was about a factor of three longer than that of a PWR and ~ 50% longer than that of a boiling water reactor. The results of the first measurements of power spectral densities with ^{252}Cf for a water moderated reactor are presented.

20650 (DOE/TIC—11162) **EBR-II operating experience.** Smith, C.R.F. (Argonne National Lab., IL (USA)). Jul 1978. Contract W-31-109-ENG-38. 220p. Dep. NTIS, PC A10/MF A01.

Operation of the EBR-2 reactor is presented concerning the performance of the heat removal system; reactor materials; fuel handling system; sodium purification and sampling system; cover-gas purification; plant diagnostics and instrumentation; recent improvements in identifying fission product sources in EBR-2; and EBR-2 safety.

20651 (EGG/LTR-LO—87-80-132) **LOFT Experimental Measurements Branch analysis of a transient load measuring system.** Good, R.R.; Meachum, T.R. (Idaho National Engineering Lab., Idaho Falls (USA)). 17 Mar 1980. Contract EY-76-C-07-1570. 78p. Dep. NTIS, PC A05/MF A01.

An analysis of the performance of a load measuring system is presented. The load system was designed to measure the weight of a pressure vessel containing high pressure and temperature water. The uncertainty and frequency response of the system are quantified for both steady state and dynamic conditions as is the repeatability of the test rig. Computation of the mass flow exiting the system during explosive decompression of the system is also presented.

20652 **Critical assembly of uranium enriched to 10% in uranium-235.** Hansen, G.E.; Paxton, H.E. (Los Alamos Scientific Lab., NM). *Nucl. Sci. Eng.;* **72**: No. 2, 230-236(Nov 1979).

Big Ten is described in the detail appropriate for a benchmark critical assembly. Characteristics provided are spectral indexes and a detailed neutron flux spectrum, Rossi-α on a reactivity scale established by positive periods, and reactivity coefficients of a variety of isotopes, including the fissionable materials. The observed characteristics are compared with values calculated with ENDF/B-IV cross sections.

PLUTONIUM AND ISOTOPE PRODUCTION REACTORS

20653 (DP—1542) **Confinement of airborne radioactivity. Final progress report, January-December 1978.** Evans A.G. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Feb 1980. Contract EY-76-C-09-0001. 32p. Dep. NTIS, PC A03/MF A01.

A new test method has been developed at the Savannah River Laboratory for evaluating the iodine retention capabilities of carbon

used in the airborne-activity confinement system. Methyl iodide tagged with I-131 is injected into a test gas stream continuously for 5 hours with test conditions of 80°C temperature, 95% relative humidity, and 55 feet per minute linear flow velocity. Results show that the CH_3I retention efficiency is independent of the inlet CH_3I concentration over the range of at least 0.9 to 200 $\mu g/m^3$ in the test gas stream. The method was also used to evaluate the effects of paint fumes on in-service carbons and showed that solvent exposure reduced carbon service life by 5 to 7 months. Experimental carbons both before and after service exposure in the SRP carbon test facility were also evaluated.

20654 (ORNL/TM—7303) **High flux isotope reactor quarterly report, July 1979-September 1979.** Corbett, B.L.; McCord, R.V.; Poteet, K.H. (Oak Ridge National Lab., TN (USA)). Apr 1980. Contract W-7405-ENG-26. 22p. Dep. NTIS, PC A02, MF/A01.

Routine reactor operation with four end-of-cycle shutdowns and two unscheduled shutdowns resulted in an on-stream time of 89.9%. Operating data for the quarter are included.

REACTOR SAFETY

REFER ALSO TO CITATION(S) 20034, 20641, 21101

20655 (CONF-791008—5) **Ultrasonic dynamic imaging (UDI) system to determine the size and velocity of large spherical simulated bubbles in liquids.** Lattimer, J.; Fitting, D.W.; Adler, L. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 4p. Dep. NTIS, PC A02/MF A01.

From ASNT fall conference; St Louis, MO, USA (15 Oct 1979).

As part of the nuclear safety program it is desirable to fully characterize the dynamics of a vapor bubble formed in liquid sodium. The bubble would be formed during the hypothetical case of partial core vaporization in a liquid-metal reactor. A real-time ultrasonic imaging system was developed which provides simultaneous measurement of the rise velocity and radius of large spherical bubbles. The range of applicability of the UDI system has been determined in model experiments.

20656 (CONF-791103—92) **SAS3D analysis of natural convection boiling behavior in the Sodium Boiling Test Facility.** Klein, G.; Dunn, F. (Oak Ridge National Lab., TN (USA); Argonne National Lab., IL (USA)). 1979. Contract W-7405-ENG-26. 6p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

The objective of the initial phase of testing in the Sodium Boiling Test (SBT) Facility, at the Oak Ridge National Laboratory, was to determine the maximum power that could be transferred by a simulated breeder reactor coolant subchannel when the coolant flow is driven by natural convection. In order to aid in the evaluation of the experimental data and to help understand the flow regimes present at the various power levels examined during this test program, a SAS3D computer model of the SBT Facility was developed.

20657 (CONF-800403—27) **Evaluation of the thermal-hydraulic response and fuel rod thermal and mechanical deformation behavior during the power burst facility test LOC-3.** Yackle, T.R.; MacDonald, P.E.; Broughton, J.M. (Idaho National Engineering Lab., Idaho Falls (USA)). 1980. Contract EY-76-C-07-1570. 8p. Dep. NTIS, PC A02/MF A01.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

An evaluation of the results from the LOC-3 nuclear blowdown test conducted in the Power Burst Facility is presented. The test objective was to examine fuel and cladding behavior during a postulated cold leg break accident in a pressurized water reactor (PWR). Separate effects of rod internal pressure and the degree of irradiation were investigated in the four-rod test. Extensive cladding deformation (ballooning) and failure occurred during blowdown. The deformation of the low and high pressure rods was similar; however, the previously irradiated test rod deformed to a greater extent than a similar fresh rod exposed to identical system conditions.

20658 (CONF-800403—35) **Results of small break LOCA experiments in the LOFT reactor system with comparison to code calculations.** Adams, J.P.; Linebarger, J.H.; Leach, L.P. (EG and G Idaho, Inc., Idaho Falls (USA)). 1980. Contract EY-76-C-07-1570. 9p. Dep. NTIS, PC A02/MF A01.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

The results are presented of three small break loss-of-coolant experiments performed in the LOFT Pressurized Water Reactor (PWR) system. Experiment L3-0, performed without reactor power, represented a loss of coolant from the power operated relief valve on the top of the pressurizer. Experiments L3-1 and L3-2 were initiated with the reactor at full power (maximum linear heat generation rate approximately 52 kW/m) and represented 4-in and 1-in diameter breaks, respectively, in the reactor inlet piping of a commercial PWR. Comparisons of data to analytical model calculations with a number of different models indicate that most major phenomena were correctly calculated, but that improvements in modeling small break behavior are necessary.

20659 (CONF-800434—3) **Behavior of sodium oxide, uranium oxide and mixed sodium oxide-uranium oxide aerosols in a large vessel.** Adams, R.E.; Han, J.T.; Kress, T.S.; Silberberg, M. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 20p. Dep. NTIS, PC A02/MF A01.

From CSNI specialist meeting on nuclear aerosols in reactor safety; Gatlinburg, TN, USA (15 Apr 1980).

Results are reported for experiments on the behavior of sodium oxide aerosols, uranium oxide aerosols, and various mixtures of these in the Nuclear Safety Pilot Plant (NSPP) vessel at Oak Ridge National Laboratory. The NSPP program, sponsored by the Nuclear Regulatory Commission, is to provide experimental qualification of the HAARM-3 aerosol behavioral code being independently developed at Battelle-Columbus Laboratories. The results of fourteen single-component and six mixed-component aerosol experiments are presented along with selected comparisons with code predictions.

20660 (CONF-800454—1) **Depending on the Grace of God is no way to protect the health and safety of the public.** Bender, M. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 8p. Dep. NTIS, PC A02/MF A01.

From ANS executive conference; Washington, DC, USA (20 Apr 1980).

Aspects of nuclear power plant safety are discussed.

20661 (CONF-800607—13) **FRAP-T5 predictions during reactor shutdown events.** Peeler, G.B.; Laats, E.T. (Idaho National Engineering Lab., Idaho Falls (USA)). 1980. Contract EY-76-C-07-1570. 8p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society annual meeting; Las Vegas, NV, USA (8 Jun 1980).

The Transient Fuel Rod Analysis Program, FRAP-T5, was recently assessed by EG and G Idaho, Inc. As part of this assessment, the measured and FRAP-T5 predicted fuel centerline temperature response during reactor shutdown events were compared. For these events either forced convection or nucleate boiling boundary conditions existed, resulting in a negligible effect on fuel behavior from cladding temperature and deformation uncertainties. This allowed the assessment of internal heat transfer to be emphasized.

20662 (CONF-800607—16) **Vapor explosion in the RIA-ST-4 experiment.** El-Genk, M.S. (EG and G Idaho, Inc., Idaho Falls (USA)). 1980. Contract EY-76-C-07-1570. 12p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society annual meeting; Las Vegas, NV, USA (8 Jun 1980).

A concern in assuring the safety of commercial light water reactors (LWRs) is whether core overheating, during which molten fuel is produced, can lead to massive vaporization of the coolant and shock pressurization of the system due to an energetic molten fuel-coolant interaction (MFCI). The RIA-ST-4 experiment was one of four scoping tests in the Reactivity Initiated Accident (RIA) Test Series which is being conducted in the Power Burst Facility (PBF) to define an energy deposition failure threshold and to determine modes and consequences of fuel rod failure during a postulated boiling water reactor (BWR) control rod drop accident.

20663 (DOE/TIC—11172) **Three Mile Island a year later.** Trauger, D.B. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 8p. Dep. NTIS, PC A02/MF A01.

Information concerning the Three Mile Island-2 reactor accident and its consequences is presented.

20664 (GA-A—15582) **Containment atmosphere response (CAR) program. Second status report.** Landoni, J.A. (General Atomic Co., San Diego, CA (USA)). Mar 1980. Contract AT03-76ET35300. 98p. Dep. NTIS, PC A05/MF A01.

This report contains a summary of the work performed under the Containment Atmosphere Response (CAR) Program of the High-Temperature Gas-Cooled Reactor (HTGR) Safety Research Task since the publication of the previous status report (February 1978). The work concentrated on development of models describing containment phenomena during core heatup in support of probabilistic risk assessment studies. Models were completed for fission product iodine sorption on coated surfaces, diffusivity and retentivity of untreated concrete, iodine interaction with condensing steam on the containment atmosphere boundaries, and the cleanup filter system. These models were incorporated into a new computer program called CARCAS, a substantial extension of the CNTB computer

program, and applied to Accident Initiation and Progression Analysis for Phase II core heatup sequences. Development was begun on models describing the postulated behavior of particulate fission products or aerosols within and leaking out of the containment.

20665 (GA-A—15622) **Risk assessment of major fires in an HTGR plant.** Fleming, K.N. (General Atomic Co., San Diego, CA (USA)). Apr 1980. Contract AT03-76ET35300. 24p. (CONF-800403—38). Dep. NTIS, PC A02/MF A01.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

The HTGR Risk Assessment Study has been extended to include major fires as initiating events. The major aspects of this study have included the development of methodology, the collection and interpretation of fire experience data and the application of these methods and data to an HTGR plant. Qualitative and quantitative methods were derived to screen a nuclear plant layout and identify important fire locations. A fire propagation model was used in conjunction with experience data and detailed fault tree analyses to estimate common cause failure probabilities associated with a spectrum of potential fires. It was determined that fires make a significant contribution to the HTGR risk assessment only at accident frequency levels below 10^{-7}/reactor-year.

20666 (GA-A—15625) **Path to development of quantitative safety goals.** Joksimovic, V.; Houghton, W.J. (General Atomic Co., San Diego, CA (USA)). Apr 1980. Contract AT03-76ET35300. 11p. (CONF-800403—39). Dep. NTIS, PC A02/MF A01.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

There is a growing interest in defining numerical safety goals for nuclear power plants as exemplified by an ACRS recommendation. This paper proposes a lower frequency limit of approximately 10^{-4}/reactor-year for design basis events. Below this frequency, down, to a small frequency such as 10^{-6}/reactor-year, safety margin can be provided by, say, site emergency plans. Accident sequences below 10^{-6} should not impact public safety, but it is prudent that safety research programs examine sequences with significant consequences. Once tentatively agreed upon, quantitative safety goals together with associated implementation tools would be factored into regulatory and design processes.

20667 (GA-A—15649) **Monte Carlo method for uncertainty analysis of HTGR accident consequences.** Wakefield, D.J.; Barsell, A.W. (General Atomic Co., San Diego, CA (USA)). Apr 1980. Contract AT03-76ET35300. 11p. (CONF-800403—40). Dep. NTIS, PC A02/MF A01.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

A method for propagating the uncertainties in the prediction of postulated accident consequences was devised. The method uses simplified mathematical models, derived from first principles and detailed deterministic computer model results to describe controlling physical processes in the transport of radioactive material from the plant and resulting population doses and health effects. These simplified models are used in a computationally efficient Monte Carlo error propagation technique. The approach is shown to be useful for uncertainty analysis of core heatup accidents postulated for the High Temperature Gas-Cooled Reactor. In combination with accident frequency predictions, the method provides the complementary cumulative risk curves typically used to present the final results of a risk assessment study.

20668 (GEFR-SP—180) **Optimum few-group cross section set for HCDAs in heterogeneous LMFBRs.** Choong, P.T.; Kujawski, E. (General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.). 6 Nov 1979. Contract AM03-76SF00893. 6p. (CONF-800607—32). Dep. NTIS, PC A02/MF A01.

From American Nuclear Society annual meeting; Las Vegas, NV, USA (8 Jun 1980).

The loss of sodium in a hypothetical transient with failure to scram proceeds sequentially. In heterogeneous cores, the high power-to-flow fuel regions during the accident will boil first and voiding will propagate to the internal blankets with some time lag. Ideally the multigroup cross sections should take this into account. It would be unrealistic to attempt to generate different multigroup cross sections for each phase of the transient. The objective is to present a simple to implement and yet quite accurate scheme for generating an optimal multigroup cross section set for use in hypothetical core disruptive accidents (HCDA) analysis of heterogenous LMFBRs. Based on present and the past design procedures, five sets of multigroup cross section sets have been generated for calculating flowing sodium void reactivities of heterogeneous cores.

20669 (HEDL-SA—1919-FP) **FFTF primary system transition to natural circulation from low reactor power.** Bouchey, G.D.; Additon, S.L.; Nutt, W.T. (Department of Energy, Richland, WA (USA). Richland Operations Office; Hanford Engineering Development Lab., Richland, WA (USA)). Jan 1980. Contract EY-76-C-14-2170. 18p. (CONF-800226—4). Dep. NTIS, PC A02/MF A01.

From Specialists meeting on decay heat removal and natural circulation in FBR's; Upton, NY, USA (28 Feb 1980).

Plans for reactor and primary loop natural circulation testing in the Fast Flux Test Facility (FFTF) are summarized. Detailed pretest planning with an emphasis on understanding the implications of process noise and model uncertainties for model verification and test acceptance are discussed for a transition to natural circulation in the reactor core and primary heat transport loops from initial conditions of 5% of rated reactor power and 75% of full flow.

20670 (IDO—1570-T37) **LOFT results demonstrate resistance of unpressurized PWR fuel to loss-of-coolant accidents.** Russell, M.L. (EG and G Idaho, Inc., Idaho Falls (USA)). 1980. Contract EY-76-C-07-1570. 6p. Dep. NTIS, PC A02/MF A01.

Portions of document are illegible.

The initial visual examination of LOFT unpressurized fuel and evaluation of data recorded during the first three LOFT large-break, loss-of-coolant experiments (LOCE's) indicated the LOFT fuel to be in a reusable condition. Since the September 1977 core load, the LOFT fuel assemblies have been exposed to three large-break loss-of-coolant experiments; LOCE L1-5 without nuclear heat and LOSE's L2-2 and L2-3 with a 26 and 39 kw/m peak fuel rod linear heat generation rate at test initiation. The LOFT power operation has resulted in a cumulative fuel burnup of 987 megawatt-days per metric ton of uranium and linear heat generation levels of up to 53 kw/m at the peak power location.

20671 (SAN—1359-T1) **Mathematics clinic. Nuclear safety code study.** (Harvey Mudd Coll., Claremont, CA (USA)). Jan 1980. Contract EG-77-S-03-1359. 31p. Dep. NTIS, PC A03/MF A01.

What would happen during an overpower accident in an LMFBR is analyzed. To assist studying the problem, Rockwell Energy Systems Group is currently developing a model of an overpower accident. It is the responsibility of this year's Nuclear Safety Code Study team to develop a useable algorithm for numerical evaluation of the stiff equations which are expected to constitute a majority of the model.

20672 (SAND—79-1999C) **Phenomenological modelling of steam explosions.** Corradini, M.L.; Drumheller, D.S. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 9p. (CONF-800403—20). Dep. NTIS, PC A02/MF A01.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

During a hypothetical core meltdown accident, an important safety issue to be addressed is the potential for steam explosions. This paper presents analysis and modelling of experimental results. There are four observations that can be drawn from the analysis: (1) vapor explosions are suppressed by noncondensible gases generated by fuel oxidation, by high ambient pressure, and by high water temperatures; (2) these effects appear to be trigger-related in that an explosion can again be induced in some cases by increasing the trigger magnitude; (3) direct fuel liquid-coolant liquid contact can explain small scale fuel fragmentation; (4) heat transfer during the expansion phase of the explosion can reduce the work potential.

20673 (SAND—79-2142C) **Fires: what plant locations should we really protect.** Berry, D.L. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 8p. (CONF-800403—36). Dep. NTIS, PC A02/MF A01.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

A fire protection analysis technique was developed from earlier work involving the protection of nuclear power plants against acts of sabotage. Characteristics unique to fire phenomena were used to modify the sabotage analysis methodology. These characteristics include the effects of fuel loads, ventilation rates, heat loss areas, barrier ratings, and plant locations. The new fire analysis technique was applied to an example nuclear power plant having 85 different plant areas. It was found that some safety and nonsafety areas were both highly vulnerable to fire spread and important to overall safety, while other areas were found to be of marginal importance to fire safety.

20674 (SAND—80-0672) **Draft report: a selection methodology for LWR safety R and D programs and proposals.** Husseiny, A.A.; Ritzman, R.L. (Science Applications, Inc., Ames, IA (USA)). Mar 1980. Contract EY-76-C-04-0789. 237p. (ALO—67; SAI—102-80-AM). Dep. NTIS, PC A11/MF A01.

The results of work done to develop a methodology for selecting LWR safety R and D programs and proposals is described. A critical survey of relevant decision analysis methods is provided including the specifics of multiattribute utility theory. This latter method forms the basis of the developed selection methodology. Details of the methodology and its use are provided along with a sample illustration of its application.

20675 (SAND—80-0803C) **Steam explosion studies with single drops of molten refractory materials.** Nelson, L.S. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 9p. (CONF-800403—18). Dep. NTIS, PC A02/MF A01.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

Laser heating, levitation melting, and metal combustion were used to prepare individual drops of molten refractory materials which simulate LWR fuel melt products. Drop temperatures ranged from $\approx$ 1500 to $>$ 3000K. These drops, several millimeters in diameter, were injected into water and subjected to pressure transients ($\approx$ 1MPa peak pressures) generated by a submerged exploding bridgewire. Molten oxides of Fe, Al and Zr could be induced to explode with bridgewire initiation. High speed films showed the explosions with exceptional clarity, and pressure transducer records could be correlated with individual frames in the films. Pressure spikes one or two MPa high were generated whenever an explosion occurred. Debris particles were mostly spheroidal, with diameters in the range 10 to 1000 μm.

20676 (SAND—80-0833C) **Modelling of molten fuel/concrete interactions.** Muir, J.F.; Benjamin, A.S. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 13p. (CONF-800403—21). Dep. NTIS, PC A02/MF A01.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

A computer program modelling the interaction between molten core materials and structural concrete (CORCON) is being developed to provide quantitative estimates of fuel-melt accident consequences suitable for risk assessment of light water reactors. The principal features of CORCON are reviewed. Models developed for the principal interaction phenomena, inter-component heat transfer, concrete erosion, and melt/gas chemical reactions, are described. Alternative models for the controlling phenomenon, heat transfer from the molten pool to the surrounding concrete, are presented. These models, formulated in conjunction with the development of CORCON, are characterized by the presence or absence of either a gas film or viscous layer of molten concrete at the melt/concrete interface. Predictions of heat transfer based on these models compare favorably with available experimental data.

20677 (SAND—80-0937C) **LOCA analyses for nuclear steam supply systems with upper head injection.** Byers, R.K.; Bartel, T.J. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 8p. (CONF-800403—25). Dep. NTIS, PC A02/MF A01.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

The term Upper Head Injection describes a relatively new addition to a nuclear reactor's emergency cooling system. With this feature, water is delivered directly to the top of the reactor vessel during a loss-of-coolant accident, in addition to the later injection of coolant into the primary operating loops. Established computer programs, with various modifications to models for heat transfer and two-phase flow, were used to analyze a transient following a large break in one of the main coolant loops of a reactor equipped with upper head injection. The flow and heat transfer modifications combined to yield fuel cladding temperatures during blowdown which were as much as 440K (800°F) lower than were obtained with standard versions of the codes (for best estimate calculations). The calculations also showed the need for more uniformity of applications of heat transfer models in the computer programs employed.

20678 (SAND—80-0939C) **Two-phase jet loads.** Tomasko, D. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 16p. (CONF-800403—23). Dep. NTIS, PC A02/MF A01.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

Two-phase jets are currently being studied to improve engineering models for the prediction of loads on pipes and structures during LOCAs. Multi-dimensional computer codes such as BEACON/MOD2, CSQ, and TRAC-P1A are being employed to predict flow characteristics and flow-structure loading. Our ultimate goal is to develop a new approximate engineering model which is superior to the F.J. Moody design model. Computer results are compared with data obtained from foreign sources, and a technique for using the TRAC-P1A vessel component as a containment model is presented. In general, good agreement with the data is obtained for saturated stagnation conditions; however, difficulties are encountered for subcooled stagnation conditions, possibly due to nucleation delay and non-equilibrium effects.

20679 (SAND—80-0947C) **Structural response to a steam explosion in a PWR.** Woodfin, R.L.; Voelker, L.E. (Sandia Labs., Albuquerque, NM (USA); Sandia Labs., Livermore, CA (USA)). 1980. Contract EY-76-C-04-0789. 8p. (CONF-800403—22). Dep. NTIS, PC A02/MF A01.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

Beginning with the assumption that a hypothetical steam-explosion occurs in the pressure vessel of a pressurized water reactor, the structural consequences are investigated. A simplified model of an individual installation is used for the investigation. Finite element and finite difference analyses of water-head impact conditions are described. Analysis of the possibility of ejection of a control rod drive assembly as a missile is investigated. Conclusions indicate that the only containment threatening consequence is the possible but unlikely generation and flight of such a missile and that large, i.e., whole head sized missiles, appear precluded.

20680 (UCID—18135-79-3) **US NRC/LLL liaison with the Federal Republic of Germany for the GKSS-DAS steam condensation tests. Progress report No. 3.** McCauley, E.W.; Holman, G.S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 Sep 1979. Contract W-7405-ENG-48. 100p. Dep. NTIS, PC A15/MF A01.

The GKSS-DAS test program has completed the pretest experimental program and initiated the main test series with two experiments in September 1979. A firm liaison has been established and, as a result of the latest trip to the facility, significant additional data has been obtained and arrangements for further data transfer have been made. The focus of our present activities has been placed on ensuring that received data, both in plotted and digital form, can be interpreted in a useful and unambiguous manner for usage by the US NRC. In this regard, attention has been directed to the treatment of high speed data, effects of fluid-structure interaction. correlation of digital and visual data, and methods of test characterization.

20681 **Simultaneous freezing and melting in finite media.** Hakim, S.J. (Argonne National Lab., IL). *Nucl. Sci. Eng.;* **72**: No. 2, 129-139(Nov 1979).

From ASME winter meeting on simultaneous melting and freezing in the impingement region of a liquid jet; San Francisco, CA, USA (Win 1978).

Simultaneous crust growth in a fluid and the melting of an adjacent colder strcture surface in contact with it are examined with emphasis on fast breeder reactor safety applications. The calculations were made subject to the following assumptions: (1) As long as a crust exists, melted structure adjacent to it stays in place until its melts. (2) When a crust melts, melted structure is ablated. The ablation process does not influence the temperature profile in the remaining intact structure. The dependence of the Fourier number at which complete structure melting occurs on fluid-to-crust heat flux is obtained for uranium oxide and thorium oxide crusts forming on steel surfaces. The crust behavior is also investigated as the heat flux is varied. The dependence of the results on internal heat generation and the Biot number on the other side of the structure is determined.

20682 **Safety consideration and economic advantage of a new underground nuclear power plant design.** Lyczkowski, R.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.); Ching, J.T. (California Univ., Berkeley (USA). Dept. of Nuclear Engineering). *Nucl. Eng. Des.;* **53**: No. 2, 257-261(Jul 1979).

A conceptual design of an underground nuclear power plant is proposed to make undergrounding of nuclear reactors not only environmentally desirable but also economically feasible. Expedient to the underground environment, this design capitalizes on the pressure-containing and radiation filtering characteristics of the new underground boundary conditions. Design emphasis is on the containment of a catastrophic accident - that of a reactor vessel rupture caused by external means. The High Capacity Rapid Energy Dissipation Underground Containment (HiC-REDUCE) system which efficiently contains loss-of-coolant accidents (LOCAs) and small break conditions is described. The end product is a radiation-release-proof plant which, in effect, divorces the public from the safety of the reactor.

20683 **Optimum nuclear pin bundle for prototypic thermal-hydraulic environment in large-scale testing.** Nguyen, D.H. (Sandia Labs., Albuquerque, NM (USA)). *Nucl. Eng. Des.;* **53**: No. 2, 207-215(Jul 1979).

The optimum number of fuel pins in a test vehicle to achieve prototypic thermal-hydraulic conditions at the onset of pin failure has been determined. The power history considered was a prompt burst superposed on a low steady state power level. Slower transients without pre-clad-failure boiling did not change the conclusions presented. The analysis used the computer program COBRA-IV-I, with a unique capability of large wire-wrapped asymmetric rod bundles up to 217 pins. The results indicate that a 61-pin test scale is desirable to achieve thermal-hydraulic conditions for prototypic testing, with 37 pins probably an acceptable minimum.

ENERGY STORAGE

THERMAL

REFER ALSO TO CITATION(S) 20362, 20395, 20455, 20456, 20457, 20458, 20459, 20460, 20461, 20462, 20463, 20464, 20465, 20563, 20792, 20842

20684 (DOE/ER/10343—1) **Fundamental heat transfer processes related to phase change thermal storage media.** Sparrow, E.M.; Ramsey, J.W. (Minnesota Univ., Minneapolis (USA). Dept. of Mechanical Engineering). Mar 1980. Contract AC02-79ER10343. 15p. Dep. NTIS, PC A02/MF A01.

Research on fundamental heat transfer processes which occur in phase-change thermal storage systems is described. Four research problems were investigated - two involving freezing and two involving melting. The freezing studies led to the discovery of new phenomena which should have a significant impact on the functioning of phase-change storage devices. It was found that under certain operating conditions, freezing can be drastically retarded and even terminated by natural convection. Under other operating conditions, the dominance of natural convection in the freezing process ultimately gives way to a freezing mode controlled by heat conduction in the solidified material. By taking account of geometrical and thermal symmetry, the relationship between freezing about a single vertical tube and about an array of vertical tubes was established. The melting studies were focused on determining quantitative data for the heat transfer coefficients in two basic phase-change systems. One of these is an array of horizontal tubes and the other is a single vertical tube. The experiments involved parametric variations of the heating rate and of the degree of subcooling of the melting solid.

CHEMICAL

REFER ALSO TO CITATION(S) 20462

BATTERIES

DESIGN AND DEVELOPMENT

REFER ALSO TO CITATION(S) 20694

20685 (UCRL-Trans—11536) **Aluminum-air battery.** Despic, A.; Drazic, D.; Zecevic, S. Nov 1979. Translation source information not available. 12p. Dep. NTIS, PC A02/MF A01.

An investigation of aluminum alloyed with small amounts (less than 0.1%) of In, Ga, and Tl in an aluminum-air battery with 2M NaCl as the electrolyte is reported. The tested laboratory model of the battery with a total weight of about 500 g operated at a total current of 8 A ($j = 30$ mA/cm^2) and a voltage of about 1 V for 7 hours. Replacing the electrolyte increased the discharge time severalfold, with the number of replacements depending on the selected initial thickness of the Al anode. It was shown that optimizing the design permitted up to 500 Wh/kg to be attained with periodic replacement of the electrolyte, or about 100 Wh/kg without replacement of the electrolyte. A number of suitable uses for this battery, especially for special-purpose batteries, are suggested. 8 figures, 1 table.

20686 (UCRL-Trans—11533) **Metal-air battery with replaceable anodes.** Nov 1979. Translation source information not available. 7p. Dep. NTIS, PC A02/MF A01.

In a metal (aluminum, magnesium, etc.)-air battery with consumable electrodes it is necessary that the anodes be replaced in the simplest possible manner. Moreover, during operation the anodes become thinner uniformly over their entire surface and, in order to maintain a constant distance between the anode and cathode, the battery must be designed so that, by use of a spring, for example, one of the electrodes is pushed toward the other in such a way that it is constantly pressed down against a distance gage (spacer) that is inserted between them. This invention solves both the problem of anode replacement and the problem of maintaining a constant distance in a very simple fashion.

20687 (UCRL-Trans—11534) **Anodic behavior of Al and the alloys Al-In and Al-In-Ga in aluminum-air batteries.** Drazic, D.M.; Despic, A.R.; Zecevic, S.K. Nov 1979. Translation source information not available. 12p. Dep. NTIS, PC A02/MF A01.

By recording of the polarization characteristics and measurement of the currents of self-dissolution, the anodic behavior of aluminum and the alloys Al-In and Al-In-Ga was tested under the operating conditions of aluminum-air batteries. The tests were conducted in an aqueous solution of 2M NaCl, and the results obtained were compared with the results obtained from a special test of these alloys as the anode in a standard electrochemical cell. Under the operating conditions of the battery, less utilization of the anode material occurs; in the presence of a carbon-air electrode the current of self-dissolution increases. Consumption of water by evaporation can be quite significant. In addition, hydrogen gas bubbles form during self-dissolution of the anode; these bubbles produce increasing amounts of $Al(OH)_3$ gel and reduce the working surface of the Al electrode. It is concluded that the principal problem in operation of an Al-air system stems from the product of aluminum oxidation-$Al(OH)_3$ gel-which, if converted into a readily precipitable form, would enable greatly increased battery capacity. 6 figures. (RWR)

20688 **Electrochemical cell and method of assembly.** Shimotake, H.; Voss, E.C.H.; Bartholme, L.G. (to Dept. of Energy). US Patent 4,172,926. 30 Oct 1979. Filed date 29 Jun 1978. 8p.

PAT-APPL-920,414.

A method of preparing an electrochemical cell is disclosed which permits the assembly to be accomplished in air. The cell includes a metal sulfide as the positive electrode reactant, lithium alloy as the negative electrode reactant, and an alkali metal; molten salt electrolyte. Positive electrode reactant is introduced as Li_2-FeS_2, a single-phase compound produced by the reaction of Li_2S and FeS. The use of this compound permits introduction of lithium in an oxidized form. Additional lithium can be introduced in the negative electrode structure enclosed within an aluminum foil envelope between layers of porous aluminum. Molten salt electrolyte is added after assembly and evacuation of the cell by including an interelectrode separator that has been prewet with an organic solution of KCl.

20689 (SERI/TP—31-248(Vol.2)(Pt.2), pp 423-428) **Room temperature aqueous batteries.** Oct 1979.

From Reliability of materials for solar energy workshop; Denver, CO, USA (18 Dec 1978).

Zinc-chlorine batteries are considered. Theory, cell design, electrodes, electrolyte, advantages, and problems are taken up. Only the viewgraphs for the talk are given here; there is no text. (RWR)

20690 **Metal-halogen cell operation with storage of halogen via organic complexation external to the electrochemical cell.** Putt, R.A.; Montgomery, M.J. (to Electric Power Research Inst., Inc.). US Patent 4,162,351. 24 Jul 1979. Filed date 12 Oct 1977. 8p.

A zinc-halogen cell system is provided in which the electrolyte circulates between the cell and an external storage for the halogen that provides the electrolyte with the necessary halogen concentration for efficient operation, energy efficiencies of about 70% being typically achieved.

20691 **Electrically regenerable electrochemical system of negative and positive electrodes and a movable diaphragm arrangement fixed in the electrolyte between the electrodes.** McCoy, L.R. (to North American Rockwell Corp., El Segundo, CA (USA); Deutsches Patentamt, Muenchen (Germany, F.R.)). German(FRG) Patent 2,213,022/C/. 5 Oct 1978. 7p. (In German).

To get a high cyclic life at high current denities, part of the electrode surfaces (between 20 and 80 %) is covered with a rotating disk that has an opening. The charging or discharging current flows only through the opening of the rotating disk.

PERFORMANCE AND TESTING

20692 (SAND—79-2292C) **Modified Li/SO_2 cells for long-life applications.** Levy, S.C. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 14p. (CONF-800612—2). Dep. NTIS, PC A02/MF A01.

From 29. power sources conference; Atlantic City, NJ, USA (9 Jun 1980).

A 6-year test program to evaluate an ambient-temperature Li primary battery was initiated on cells from two manufacturers. Three modes of premature failure were observed in Li/SO_2 cells: corrosion of the lithium-to-can contact, corrosion of the glass in the glass-to-metal seal in the header, and corrosion at the Al-Ta weld in the positive lead. Potential fixes for each of these failure modes were incorporated into cells from two suppliers, and accelerated tests of these cells have begun. 2 figures, 1 table. (RWR)

20693 (SAND—80-5080C) **Accelerated aging of thermally activated batteries which utilize the Li(Si)/LiCl-KCl/FeS_2 system.** Searcy, J.Q.; Neiswander, P.A. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 23p. (CONF-800612—1). Dep. NTIS, PC A02/MF A01.

From 29. power sources conference; Atlantic City, NJ, USA (9 Jun 1980).

Sandia Laboratories is developing Li(Si)/FeS_2 thermally activated batteries for applications that require high reliability and a shelf life of twenty-five years. To determine the feasibility of achieving these requirements, an accelerated aging study was undertaken. The major objective of this work was to identify deleterious chemi-

cal reactions that could affect performance and reliability during the twenty-five year shelf life. The approach used was to accelerate the aging of batteries by storage at elevated temperature, and then to examine and analyze materials from some batteries, while discharging others. A battery design that used no organic materials (except for those in an electrical match) was chosen in order to minimize the number of possible deleterious reactions. The reaction of Li(Si) with water outgased from the various battery parts was the only effect deleterious to shelf life that was noted. 4 figures, 4 tables. (RWR)

MATERIALS, COMPONENTS, AND AUXILIARIES

REFER ALSO TO CITATION(S) 20688, 20690, 20987

20694 (UCRL-Trans—11532) **New results in development of aluminum-air batteries with a neutral electrolyte.** Drazic, D.M.; Despic, A.R.; Zecevic, S.; Jovanovic, L.; Gajic, L. Nov 1979. Translation source information not available. 11p. Dep. NTIS, PC A02/MF A01.

The electrochemistry of Al anodes in 2M NaCl was investigated. The anode was shifted up and down mechanically at various amplitudes and frequencies. It was found that anodes made from commercial-grade Al (99.5%) were less suitable than those made from pure Al (99.999%) due to the presence of Cu impurity; if the use of pure Al is to be avoided, some way to neutralize the harmful effects of the impurity must be found. The amount of Al that can dissolve in the electrolyte and, thus, the lifetime of the battery depends on the dynamic conditions in the battery; during vibration of the battery the electrolyte can hold up to 0.18 g/ml without passivation of the anode. This result indicates that a 10-kW battery (e.g., for an electric automobile) with an interelectrode distance of 5 mm can continually discharge with a current density of 50 mA/cm^2 for 6 hours. If sufficiently thick anodes were used, it could then be prepared for a new discharge cycle simply by replacement of the electrolyte. 6 figures. (RWR)

20695 **Energy conversion devices.** Stacy, C.J. (to Phillips Petroleum Co.). US Patent 4,172,182. 23 Oct 1979. Filed date 21 Mar 1978. 8p.

Cured arylene sulfide polymers such as cured poly(phenylene sulfide) perform effectively in sealing or coating internal elements of alkali metal-sulfur energy conversion devices. The sealing or coating materials retain satisfactory corrosion resistance properties at elevated temperatures exceeding 300°C, and can be placed in contact with both molten alkali metal and molten sulfur. Adding carbon particles, carbon fibers, graphite, powdered metals, or metal fibers renders the sealing or coating materials electrically conductive. Novel energy-conversion-device reactant containers and novel energy conversion devices are also disclosed.

20696 **Method and apparatus for impregnation of cermet electrodes of an alkaline storage battery.** Kolosov, I.A.; Kuryshev, N.V.; Ivanyatov, J.E.; Kalininskaya, V.N.; Yartsev, I.K.; Pugachev, A.K.; Savina, S.M.;. US Patent 4,171,679. 23 Oct 1979. Filed date 18 Mar 1977. 6p.

An apparatus for effecting impregnation of cermet electrodes of an alkaline storage battery, according to the invention, comprises a tank with active solutions that accommodates a member from which electrode stock members are suspended. The stock members are made as a set of forms, each being used for a band stock to be reeled thereon together with a spacer element. The spacer element is adapted to form an appropriate space between the turns of the band stock. The spacer element is made of individual interconnected frames forming a chain of a specified length and provided with projections on both sides of longitudinal and transverse strips constituting a frame, so as to provide circulation of an active solution between the turns of the band stock.

20697 **Battery filling system.** Hoffmann, G. US Patent 4,165,769. 28 Aug 1979. Filed date 13 Jun 1977. 6p.

The invention relates to a filling system for a secondary battery. A stopper is inserted in the battery and has a liquid channel passing through it, the passage being closable by means of an inlet valve controlled by the level of the liquid in the battery. The stopper cooperates with a filling nozzle that is connected to a storage container for the filling liquid. The nozzle is movable relative to the stopper and may be inserted through a closable filling opening of the stopper. The nozzle is provided with an outlet opening associated with an outlet valve that cooperates with and is operated by an opening element carried by the stopper when the nozzle is inserted into the stopper.

20698 **Secondary battery or cell with pyrolytic graphite coated graphite current collector.** Ludwig, F.A. (to Ford Motor Co.). US Patent 4,166,156. 28 Aug 1979. Filed date 28 Feb 1977. 8p.

An improved secondary battery or cell comprises an anodic reaction zone containing a molten alkali metal reactant-anode in electrical contact with an external circuit, one or more cathodic reaction zones containing a cathodic reactant, a cation-permeable barrier to mass liquid transfer interposed between and in contact with the anodic and cathodic reaction zones, and a current collector that is at least partially exposed to the cathodic reactant and is in electrical contact with both the cation-permeable barrier and the external circuit. The cathodic reactant, when the battery or cell is at least partially discharged, is selected from the group consisting of a single-phase composition comprising molten polysulfide salts of the anodic reactant and a two-phase composition comprising molten sulfur and molten sulfur-saturated polysulfide salts of the anodic reactant. The improvement comprises employing in the device a current collector comprising a graphite body bearing a coating of pyrolytic graphite on at least those surfaces that are exposed to the cathodic reactant.

20699 **Maintenance-free battery.** Mao, G.W.; Rao, P.; Trenter, J.F. (to Gould Inc.). US Patent 4,166,155. 28 Aug 1979. Filed date 3 Jul 1978. 8p.

The present invention provides a maintenance-free battery having improved performance characteristics and utilizing a unique, hybrid combination of ternary alloys for the positive and negative grids. The positive grids are formed from a ternary lead-base alloy consisting essentially of lead, from about 1.0 to about 2.0% antimony, and from about 1.2 to about 2.2% cadmium, the cadmium being present in an amount at least equal to the amount of antimony present. The negative grids are formed from a ternary lead-base alloy consisting essentially of lead, from 0.06 to about 0.20% calcium and from about 0.10 to about 0.40% tin, the percentages of each alloy being based on the alloy weight.

20700 **Cells having cathodes derived from ammonium-molybdenum-chalcogen compounds.** Chianelli, R.R.; Jacobson, A.J.; Whittingham, M.S. (to Exxon Research & Engineering Co.). US Patent 4,166,160. 28 Aug 1979. Filed date 14 Aug 1978. 10p.

The present invention is directed to an electric current-producing cell that contains a cathode having as its cathode-active material one or more compounds selected from the following four groups: those having the formula (NH$_4$)/sub x/MoZ/sub y/, wherein Z is a chalcogen selected from the group consisting of sulfur, selenium, sulfur-selenium mixtures, sulfur-oxygen mixtures, and selenium-oxygen mixtures, wherein x is a numerical value of about 2, and y is a numerical value of about 4; compounds of the above formula wherein one or more hydrogens is substituted with a radical selected from alkyl radicals having 1 to 20 carbon atoms and alkyl amine radicals habving 1 to 20 carbon atoms; those having the formula (NH$_3$-R-NH$_3$)MoZ/sub y/, where R is a methylene radical or a polymethylene radical having 2 to 20 carbon atoms, and wherein Z and y are as defined; and the amorphous decomposition products of one or more compounds of the preceding three groups resulting from their decomposition below about 350°C.

20701 **Battery post seal.** Jensen, H.E. (to Eltra Corp.). US Patent 4,164,609. 14 Aug 1979. Filed date 8 May 1978. 6p.

An apparatus that provides a fluid seal between a battery post and battery cover is described. A first stuffing box is located around the battery post. This stuffing box contains an O-ring and a gland fitting that is screwed into the stuffing box for the purpose of squeezing the O-ring to create a fluid seal relationship between the stuffing box and the battery post. A second stuffing box is formed integrally with the battery case. This stuffing box is concentric with the first stuffing box. An O-ring is provided to create a fluid seal between the two stuffing boxes. Movement of the battery post with respect to the battery case is accommodated by movement between the two stuffing boxes.

20702 **Battery charging circuit.** Kleeberg, H. (to Triumph Werke Nurnberg, A.G.). US Patent 4,164,698. 14 Aug 1979. Priority date 13 Nov 1976, German, Federal Republic of (F.R. Germany), 4p.

A circuit for use in charging a battery from a current source, such as a solar cell, includes a Zener diode, a current-limiting resistor in series with the Zener diode, and a switch that shunts the resistor. In periods of high current output from the solar cell, the resistor is shunted to allow the Zener diode to limit the charging current to the battery in order to prevent damage to it. In periods of low current output from the solar cell, the resistor limits the power consumption of the Zener diode to insure sufficient power delivery to the battery.

20703 **Method of preparing a positive electrode for an electrochemical cell.** Tomczuk, Z. (to Dept. of Energy). US Patent 4,164,069. 14 Aug 1979. Filed date 28 Apr 1978. 6p.
PAT-APPL-901,046.

A method of preparing an electrochemical cell including a metal sulfide as the positive electrode reactant and lithium alloy as the negative electrochemical reactant with an alkali metal molten salt electrolyte is disclosed that permits the assembly to be accomplished in air. The electrode reactants are introduced in the most part as a sulfide of lithium and the positive electrode metal in a single-phase compound. For instance, Li_2FeS_2 is a single-phase com-

pound that is produced by the reaction of Li_2S and FeS. This compound is an intermediate in the positive electrode cycle from FeS_2 to Fe and Li_2S. Its use minimizes volumetric changes from the assembled to the charged and discharged conditions of the electrode and minimizes electrode material interaction with air and moisture during assembly.

20704 Automatic electric battery charging apparatus. Foster, G.W. (to Chloride Group Ltd.). US Patent 4,163,933. 7 Aug 1979. Filed date 21 Nov 1977. 6p.

The automatic electric battery charging apparatus includes at least one timer, a voltage comparator arranged to compare a reference voltage (referred to as a staircase voltage) with a control signal varying with battery voltage, jacking means rendered operative by the timer when a first predetermined time interval has elapsed and serving to increase the staircase voltage repeatedly step-by-step relative to the control signal, by equal steps, so long as the control signal exceeds the reference voltage, and terminating means for initiating the termination if the staircase voltage exceeds the control signal before the jacking means have exceeded a predetermined number of steps from the start of their operation.

20705 Method and apparatus for charging batteries. Lawn, F. US Patent 4,163,934. 7 Aug 1979. Filed date 6 Jul 1977. 16p.

The disclosed system for charging a battery provides for accurate regulation of the charging current, which is maintained constant during the initial and final phases of the charging cycle. The slope of battery-voltage increase during continued charging of the battery is monitored at frequent intervals. Failure of the battery voltage to rise more than a threshold increment during a slope-testing interval signifies full charge, and is used to terminate the charging operation. The disclosed slope detector includes a storage capacitor having a terminal that is isolated ideally from leakage-causing circuit connections. The disclosed circuit is economical in terms of low cost and avoidance of complexity, and includes provision for suppressing potentially dangerous voltages at the battery terminals when there is no connected battery and for blocking charge of a battery connected backwards and of a battery whose voltage is so low as to signify a defect rather than depleted condition.

20706 Composite electrode for storage batteries, accumulators and the like. Faber, P. (to Rheinisch-Westfalisches Elektrizitatswerk Aktiengesellschaft). US Patent 4,161,569. 17 Jul 1979. Priority date 12 Mar 1977, German, Federal Republic of (F.R. Germany), 6p.

A composite electrode for storage batteries and the like comprises a metal current-carrying support provided with a surface array of perforations and covered on opposite sides with perforate synthetic-resin layers of net, screen, fabric, or the like. These synthetic-resin layers are fused together at points through the openings of the metal support. The synthetic-resin layers may form retaining pockets for the active mass, and the latter may be covered on both sides or one side of the electrode with additional layers of porous synthetic-resin material, preferably a fleece or mat of nonwoven synthetic-resin fibers.

20707 Method and apparatus for making battery grids. Scholle, W.R. (to Scholle Corp.). US Patent 4,160,309. 10 Jul 1979. Filed date 21 Jul 1977. 10p.

An apparatus for making a battery grid is characterized by a molding die for molding a lead conductor with a plastics frame. The die has runners or channels defining the grid structure, and valves are positioned at the intersections of the channels for the lead conductor and the channels for the plastics frame. The valves are actuable to block selectively the channels for the plastics frame from the channels for the conductor. In the use of the die to form a battery grid, with the valves actuated to block the channels for plastics from the channels for lead, molten lead is injected into the proper channels and is confined there to form the conductor. The valves are then actuated to unblock the channels for plastics and hardenable plastics are injected to form the plastics frame, with the frame being molded around the conductor at intersections with it.

20708 Electrically conductive and corrosion resistant current collector and/or container. Johnson, O.W.; Miller, G.R.; Beutler, P.S. (to Univ. of Utah). US Patent 4,160,069. 3 Jul 1979. Filed date 18 Feb 1977. 20p.

An improved electrically conductive current collector suitable for use in high temperature applications in the presence of corrosive environments comprises a high-strength, noncorrosive, electronically conductive ceramic member that serves as the primary load bearing element for the current collector and a highly electronically conductive metal cladding intimately attached to a substantial portion of one surface of the ceramic member and adapted to direct current flow through the ceramic member and to shunt the current between the member and an external contact. The disclosed current collectors are ideally suited for use as current collectors and current collector/containers for electrical conversion devices such as the sodium/sulfur battery and the like. Also disclosed are two processes for preparing tantalum- or niobium-doped rutile titanium dioxide. The electronically conductive ceramics produced by these methods are ideally suited for use as the ceramic in the disclosed current collector.

20709 Apparatus for casting lead into plastic for side terminal batteries. Oxenreider, T.; Duesterhoeft, D.A.; Erb, E.M. (to General Battery Corp.). US Patent 4,158,382. 19 Jun 1979. Filed date 23 Dec 1976. 12p.

An apparatus for injecting molten lead from a reservoir into a die mold cavity formed about an aperture in the wall of a plastic battery for casting lead-alloy battery terminal connectors is described. Batteries are positioned adjacent the molten lead reservoir of the apparatus and mold portions move together to hold the battery containers in a clamp-like action. molten lead is die cast under pressure into the mold cavity in which a stainless steel threaded nut is positioned. The lead is forced through a heated chamber into a portion of the mold that may be water cooled. The mold is designed to allow venting of gases to eliminate porosity; and the apparatus is designed to provide casting that is free of jagged projections in the sprue hole. The aperture in the battery wall is surrounded by a series of plastic annular rings extending outward from the battery wall but being a part of it. The molten lead surrounds the annular rings and fills the spaces between them when it is injected into the cavity. The heat from the molten lead partially melts the plastc rings and thus forms a good seal between the casting and the battery wall.

20710 Low antimonial lead alloy for making grids for use in maintenance free batteries. Hebbar, R.K.; Rao, M.V.; Foerster, G.S. (to N L Industries, Inc.). US Patent 4,158,563. 19 Jun 1979. Filed date 11 Oct 1977. 8p.

An electric storage battery grid made from an improved low antimonial content lead alloy is disclosed. The battery grid can be used to manufacture maintenance-free lead-acid storage batteries. The alloy has an improved combination of low gassing rate and hardness, castability, and pasteability, and contains less than 2.0% (approximately 1.3 to 1.9 wt % antimony, 0.05 to 0.45 wt % arsenic, and 0.02 to 0.5 wt % tin as well as small amounts of copper and sulfur.

20711 Battery containing an alkaline electrolyte. Gadessaud, R. (to Compagnie Generale d'Electricite). US Patent 4,157,423. 5 Jun 1979. Filed date 18 Oct 1977. 8p.

A battery containing an alkaline electrolyte is described. It has within a container the electrolyte and two electrodes, separated by a separator. The separator is made of a partially reticulated polyvinyl acetal produced by acetalization on polyvinyl alcohol, preferably an aromatic aldehyde, which may also have at least one hydroxyl radical, used together with formaldehyde.

20712 Battery access system. Colbrese, N.P. US Patent 4,157,492. 5 Jun 1979. Filed date 20 Jul 1977. 8p.

An improved battery access system that can be used, not only to start the engine of a vehicle having a defective battery, but also to supply power to an external electrical apparatus, is described. The system can be entirely situated uner the hood of a vehicle, and eliminates many of the dangers associated with battery jumping.

20713 Battery of interconnected lead accumulator cells. Niklas, H.; Knabenbauer, W.; Rabenstein, H. (to Varta Batterie A.G., Hannover (Germany, F.R.)). German(FRG) Patent 2,142,768/B/. 3 May 1979. 3p. (In German).

According to the invention the cell connection for a rigid connection of lead accumulator battery functions at the same time as a cell connector which connects the plate lugs which are led through the cell caps. The cell connector is fixed on a recess of the cap, whose outside walls each have a wall part that acts as a preset breaking point from which the cell connector projects.

20714 Diffusion and ionic conductivity in sodium beta alumina. Kim, K.K.; Mundy, J.N.; Chen, W.K. (Argonne Natl Lab, Ill). *J. Phys. Chem. Solids;* **40**: No. 10, 743-755(1979).

Measurements of sodium tracer diffusion (D/sub t/) and ionic conductivity (/sigma/) have been made on the same single crystals of sodium beta-alumina of composition 1.23 Na_2O*11 Al_2O_3. The /sigma/measurements were made over the temperature 390-660 K by use of reversible (liquid sodium) electrodes. A fit to the conductivity data gives /sigma/T.2470 exp (-0.142 eV/kT)Ω^{-1} cm^{-1} K. The D/sub t/ measurements employed two techniques, i.e. nondestructive profiling over the temperature range 210-750 K and cation exchange over the temperature range 505-970 K. The results of the two techniques were in close agreement and can be expressed as $D=2.12\times10^{-4}$ exp (-0.169 eV/kT) cm^2 sec^{-1} for T>520 K and $D=2.45\times10^{-4}$ exp (-0.164 eV/kT) cm^2 sec^{-1} for T<470 K. The "transition" region between 470 and 520 K is not observed in the conductivity measurements. Silver cation exchange was used to determine the number of mobile sodium ions. This work is pertinent to battery electrolytes.

20715 Galvanic battery with negative zinc electrode and positive silver oxide electrode. Sauer, H.; Lippold, H.M.; Spahrbier, D. (to Varta Batterie A.G., Hannover (Germany, F.R.); Deutsches Patentamt, Muenchen (Germany, F.R.)). German(FRG) Patent 2,708,372/A/. 31 Aug 1978. 14p. (In German).

The invention concerns a galvanic battery with negative zinc electrode and with a positive electrode of bivalent silver oxide (AgO) insulated by an electron-nonconducting plastic layer from the positive conductor, whereby the cell operates under the discharge voltage of the Ag_2O/Zn system. The available capacity is optimized according to the invention in that the positive electrode is connected to the positive conductor only via an electron-conducting contact. The contact surface of the contact with the silver oxide is so small that, when deriving current of less than 15 μA, the formation of monovalent silver oxide and metallic silver occurs more rapidly on the contact than the oxidation of the silver, due to the electrolyte-conducting bivalent silver oxide connected to the contact.

20716 Method to coat a closure strip on tube electrodes. Huthwelker, R. (to Varta Batterie A.G., Hannover (Germany, F.R.); Deutsches Patentamt, Muenchen (Germany, F.R.)). German(FRG) Patent 2,627,977/A/. 5 Jan 1978. 7p. (In German).

The object of the invention is a method to coat continuously a closure strip made of foam plastic on the tube electrodes for lead batteries. The electrode plates are introduced with their lower edge into a molding rail. A foamable plastic (high-pressure polyethylene) is continuously coated in the form of a strip onto the tube plates entering the molding rail. This strip is taken on by the plate in the molding rail and fills the space between the molding rail and plate edge by foaming and deformation within the molding rail. The plastic strip is automatically cut off at the end of the plate.

APPLICATIONS

20717 (AD-A—072142) **Standard engineering installation package. Uninterruptible power facilities (48 volts dc). Final report.** (Army Communications Command, Fort Huachuca, AZ (USA)). 1 Jul 1979. 374p. NTIS PC A16/MF A01.

This Standard Engineering Installation Package (SEIP) assists project officers, logisticians, engineers, and technicians to program, procure, engineer, and install 48-V dc uninterruptible power facilities. The SEIP includes a discussion of principles of operation, bill of materials, installation instructions (including drawings), and test procedures.

ENERGY MANAGEMENT AND POLICY

20718 (AD-A—073190) **Technology transfer in science, technology and public policy.** Jolly, J.A.; Creighton, J.W.; Moore, B.M. (Naval Postgraduate School, Monterey, CA (USA)). 1978. 100p. NTIS, PC A05/MF A01.

Contents: Technological Interactions with Public Policy; Technology and Economics; Problems or Answers; Technology--No Policy for Giants; International Technology Transfer--Ramifications Concerning Communist Bloc Nations; The Effect of Climate on Food Production and Population; World Population Explosion--A Technological, Not Fertility, Crisis; The Computer--It Leadeth Man to Think; Computers, Privacy, and the American Public; Product Liability, and How the Engineer and Small-Business Manager Can Be Prepared; and Solar Heating of Homes--A Technology Assessement.

ENERGY ANALYSIS AND MODELING

REFER ALSO TO CITATION(S) 20734, 20735, 20736, 20739, 20748, 20785, 20802, 20804

20719 (BNL—50994) **Annual abstracts of the National Center for Analysis of Energy Systems.** (Brookhaven National Lab., Upton, NY (USA). National Center for Analysis of Energy Systems). Dec 1978. Contract EY-76-C-02-0016. 145p. Dep. NTIS, PC A07/MF A01.

The National Center for Analysis of Energy Systems at Brookhaven has been in operation since January 1976. This 1978 Annual Abstracts report illustrates the scope of activities of the Center involving the integrated analyses of technological, economic, environmental, and social aspects of energy at the regional, national, and international levels. The major ongoing activities of the Center include: analysis of energy-economic relationships; regional energy and environmental policy; comparative health effects of alternative energy systems; technology assessment and energy R and D priorities; development of energy-economic-environmental models and data bases; R and D strategies for the International Energy Agency; and energy technologies for developing countries. The objectives of the Center and major accomplishments of 1978 are described in the Annual Highlights of the National Center for Analysis of Energy Systems, BNL 50969, which also describes the energy data bases and analytical models used in the course of policy analyses. The multidisciplinary approach used in the Center, and the close interaction with other analytical groups in universities and industry, provides a unique perspective on the energy situation. This is evidenced by the broad range of activities cited in this Annual Abstracts report.

20720 (BNL—51095) **Time-stepped Energy System Optimization Model (TESOM): overview and special features.** Kydes, A.S.; Rabinowitz, J. (Brookhaven National Lab., Upton, NY (USA). National Center for Analysis of Energy Systems). Dec 1979. Contract EY-76-C-02-0016. 21p. Dep. NTIS, PC A02/MF A01.

This paper provides an overview of TESOM, a time-dependent energy integrating model used at Brookhaven National Laboratory for energy systems analysis. Special control theoretic features which act to smooth the intertemporal transitions between time periods are highlighted. These features include a new-market penetration algorithm, an explicit representation of the technological and cost behavior of inherited (vintaged) stock, and the incorporation of risk factors in resource pricing.

20721 (GU-FE—62) **Changes in energy use of industry and their consequences for input-output analyses.** Andersson, B.; Bergendahl, P.A. (Goeteborg Univ. (Sweden). Institutionen foer Foeretagsekonomiska). 1979. 145p. (In Swedish). Dep. NTIS (US Sales Only), PC A07/MF A01.

In input-output models, the energy consumption is represented by a coefficients, which shows the energy needed to produce one unit of goods in an industrial sector. This report examines the changes of the coefficient, in time and variations depending on size and location of the industry. Trends in the coefficients are found, and prognoses of the future development are made. Mining, steel, chemical, paper, and engineering industries are studied.

ECONOMICS AND SOCIOLOGY

REFER ALSO TO CITATION(S) 20035, 20734, 20737, 20740, 20741, 20744, 20748, 20750, 20751, 20752, 20773, 20805, 20810

20722 (CONF-791181—1) **Examination of some socio-economic characteristics of rural non-farm population in Southern Appalachia.** Newman, B.G. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 11p. Dep. NTIS, PC A02/MF A01.

From 34. annual meeting of the Southeast Division of the Association of American Geographers; Nashville, TN, USA (18 Nov 1979).

The rural nonfarm population in 11 contiguous Southern Appalachian counties was surveyed to study socio-economic characteristics of that population group. The 351 rural nonfarm households interviewed are more than 35 miles, or 1-h commuting distance, from six Standard Metropolitan Statistical Areas (SMSA). Case study counties are Fannin, Rabun, Towns, and Union counties, Georgia; Cherokee, Clay, Graham, Jackson, Macon, and Swain counties, North Carolina; and Polk County, Tennessee. A major objective of the study was to examine socio-economic linkages of these rural nonfarm people within the study area and with the neighboring SMSA. Socio-economic and linkage characteristics examined include age, sex, residence location, employment, trip-to-work, and socio-economic ties with SMSAs.

20723 (ORNL/TM—7196) **Changes in economic capacity at the Federal Region level due to NEP-I energy price changes.** Bjornstad, D.J. (Oak Ridge National Lab., TN (USA)). Apr 1980. Contract W-7405-ENG-26. 54p. Dep. NTIS, PC A04/MF A01.

This paper employs a microeconomic model describing the relationship between economic capacity and factor price changes to analyze how projected energy price changes may affect the manufacturing sector in major regions of the United States. For this study, projected prices are drawn from two scenarios prepared by the Department of Energy to analyze the National Energy Plan proposed by President Carter in April 1977. The analysis indicates that energy price increases between 1975 and 1985 would bring about a 4.0% decrease in economic capacity without the initiatives of the proposed plan and a 3.4% decrease with the initiatives in place. These decreases tend to be unevenly distributed among regions, with the oil- and gas-producing region (Texas, Louisiana, Oklahoma, Arkansas, and New Mexico) receiving the largest capacity decreases and the Northeast (New England, New York, and New Jersey) receiving the smallest capacity decreases. Relative to a base case, the initiatives in the President's 1977 Plan accentuate these differences and tend to place additional burdens on the oil and gas producing region.

20724 (PB—80-100019) **Socioeconomic longitudinal monitoring project.** (Wyoming Univ., Laramie (USA). Center for Urban and Regional Analysis). Jun 1979. 613p. NTIS PC E13.

20725 (PB—80-103146) **Urban goods movement.** (North Atlantic Treaty Organization, Brussels (Belgium). Committee on the Challenges of Modern Society). Jun 1978. 59p. NTIS, PC A04/MF A01.

The following six topics have been studied: (1) Traffic Problems (Fr.); (2) Technical Problems (Fr.); (3) Freight Terminals (U.S.); (4) Regulation of Commercial Use, and Planning (U.K.); (5) Demonstration of New Projects (U.S.); and (6) Coordination of Study Methods (U.K.). The first two topics concern the present situation: goods movement on urban roads is becoming increasingly difficult, and creates congestion and nuisances; the second topic highlights certain technical aspects of present delivery problems. The third and fourth topics belong together, Topic 3 studying the frequently recommended solution of local urban freight consolidation terminals, whereas Topic 4 stresses certain commercial, social or town planning aspects which are sometimes contradictory to the purely economic aspect of terminal systems (and more particularly to any 'rational' delivery system). Combining the two topics helps explain why rationalization of expensive operations is difficult to achieve. The last two topics deal with the question in a more general manner. Topic 5 summarizes alternatives for obtaining substantial short, medium or long-term improvements in urban goods movement. Topic 6 suggests means to classify commodities and vehicles for purposes of transportation planning, and suggests that the NATO Committee on the Challenges of Modern Society (CCMS) members seek to achieve greater commonality in classification schemes and commercial law and regulation.

20726 (PB—298998) **Factors related to the implementation and diffusion of new technologies: a pilot study.** (Little (Arthur D.), Inc., Cambridge, MA (USA)). Jun 1979. 125p. NTIS, PC A06/MF A01.

In order to develop an understanding of how government intervention affects the processes of implementation and diffusion of new technologies, case studies of 14 technologies were carried out: automobiles; broadcast radio; frozen foods; black and white TV; color TV; polio vaccine; supersonic transport; fluoridation of water supplies; computer-aided instruction; basic oxygen process for steel; numerical control in manufacturing; digital computers; lasers; and integrated circuit. The key factors, their motivations for implementing/adopting the technology (or not doing so), the interactions among the key factors, and how these affected implementation/adoption are examined.

20727 **Energy substitution in the UK, 1948-64.** Uri, N.D. (Department of Energy, Washington, DC). *Energy Econ.;* **1**: No. 4, 241-244(Oct 1979).

Translog specification is used to investigate the extent of interfuel substitution in the United Kingdom during the period 1948-64. The results indicate that relative changes in energy prices had significant effects on energy consumption. This has important implications for public policy. The marked system, in particular, appears to have been better able to deal with exogenous shifts in energy supplies than was frequently assumed. 17 references, 2 tables.

20728 **National overview of price- and supply-related problems with home-heating sources used by low-income people.** Calomeris, E. Washington, DC; Design Alternatives, Inc. (1979). 64p. (NP—24375). Office of Energy Programs, Community Services Adm., Washington, DC.

This report identifies the kinds of situations millions of poor and elderly Americans faced for the 1979 to 1980 heating season because of price- and supply-related problems with home heating sources, and offers recommendations to assist those in need. The information on which this report is based was gathered by way of a literature search, as well as from visits, phone interviews, and correspondence with over 1^0 Federal, state, local and volunteer agencies and others interested and knowledgable in energy problems as they relate to the poor. The report discusses: overall impacts; specific impacts (accidental hypothermina, food/home-heating tradeoffs, and safety-related dangers); potential supply-related problems (limited local supplies, conversion restraints, fuel-dealer policies, landlord abandonment, severe weather conditions, strikes, hoarding, and petroleum embargoes); rural and urban difficulties; and preparing for home-heating emergencies (self-help efforts and community efforts). It is felt that considerable Federal assistance will be required in assisting the poor and the elderly over the next decade, and recommendations are made. 54 references, 7 figures.

ENVIRONMENT, HEALTH, AND SAFETY

REFER ALSO TO CITATION(S) 20044, 20731, 20735, 20736, 20805, 21206, 21284

20729 (SAND—80-0021C) **Worst-case scenario syndrome.** Wilmot, E.L.; Luna, R.E. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 8p. (CONF-800334—10). Dep. NTIS, PC A02/MF A01.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

Worst-case scenario impacts which must be included in an environmental impact statement (EIS) are discussed. The author presents arguments against their inclusion in the EIS. The low-probability-high-risk scenarios are recalled by the public in far more cases than the realistically expected impacts. The techniques used in creating worst-case scenarios are discussed. An example is given from the EIS of the Waste Isolation Pilot Plant concerning a transportation accident. (DC)

NATURAL RESOURCES

REFER ALSO TO CITATION(S) 21224

20730 (NP—24337) **History of Federal water resources programs and policies, 1961-70.** Holmes, B.H. (Forest Service, Washington, DC (USA)). Sep 1979. 340p. GPO.

A comprehensive account of major Federal programs and policies relating to conservation and development of water and related land resources and to water pollution control in the years 1961-1970 is presented. Most of the relevant Federal legislation and the functioning of Federal and Federally-assisted programs involving research, planning, construction, and regulation are discussed. Also discussed are national, regional, and local political issues related to water programs and policies; presidential, congressional, and agency policymaking processes; and origins of the environmental movement and its effects on water resources programs and policies.

20731 (SW—779) **Choices for conservation: Resource Conservation Committee final report to the President and Congress.** (Environmental Protection Agency, Cincinnati, OH (USA)). Jul 1979. 152p. Environmental Protection Agency, Cincinnati, OH.

The Resource Conservation Committee was established under the mandate of the Resource Conservation and Recovery Act of 1976 for the purpose of studying present and proposed Federal policies that might affect the choices of individuals, industry, and governments to consume or conserve material resources. Of the Federal policies that the Committee might have selected for study, they chose ten, namely: existing Federal tax subsidies for virgin materials; extraction taxes on virgin materials; subsidies for resource recovery; railroad freight rate discrimination; product regulations; beverage container deposits; deposits and bounties on durable and hazardous goods; national litter tax; local user fees; and national solid-waste disposal charge. Most of the Executive Summary is devoted to findings and recommendations in each of these policy areas. Then, detailed analyses are presented in seven separate chapters. Other reports issued in connection with the Committee's work are listed. 10 figures, 14 tables.

RESEARCH, DEVELOPMENT, DEMONSTRATION, AND COMMERCIALIZATION

REFER ALSO TO CITATION(S) 19956, 20322

NUCLEAR ENERGY

REFER ALSO TO CITATION(S) 20133, 20135, 20635, 20637, 20646, 21284

TRANSPORT AND STORAGE

REFER ALSO TO CITATION(S) 20803, 20854, 20855

WASTE HEAT UTILIZATION

REFER ALSO TO CITATION(S) 20352, 20812, 20813, 20838, 20839, 20840

20732 (AD-A—072685) **An assessment of total energy systems for Naval industrial and non-industrial activities. Master's thesis.** Mathewson, R.L. Jr. (Naval Postgraduate School, Monterey, CA (USA)). 12 May 1978. 135p. NTIS, PC A07/MF A01.

The total energy concept has been proposed as a possible system alternative towards reducing the cost of providing the electrical and thermal power requirements of United States Naval Activities. An overview of the key factors influencing the possible shift to a total energy system approach is presented. The importance of fuel availability and accurate load profile determination are addressed. Cogeneration, including peaking operations and select energy systems are analyzed in addition to total energy systems independent of the commercial utility grid, and the value of reliability and availability analysis as another basis for comparison and selection between alternative system designs is demonstrated. The design and operational characteristics of the three principal generator prime movers--steam turbines, gas turbines and reciprocating internal combustion engines are described. The environmental factors which can influence the successful application of a total energy system installation are also considered. The background of the total energy concept and history of its development in this country are reviewed in order to explain the thrust of future research and development which is required.

20733 (AD-A—073026) **Coal-fired boilers at Navy bases, Navy energy guidance study, phase II and III. Final report for period ending May 79.** McCone, A.I.; Ruby, J.D.; Yim, Y.J.; Chen, T.P.; Terichow, O. (Bechtel National, Inc., San Francisco, CA (USA)). May 1979. Contract N68305-77-C-0003. 272p. NTIS, PC A12/MF A01.

Conceptual design and parametric cost studies of steam and power generation systems using coal-dired stoker boilers and stack gas scrubbars in several sizes were performed. Central plants containing four equal-sized boilers and central flue gas desulfurization facilities were shown to be less expensive than decentralized facilities with the four boilers plus scrubbers at diverse sites. Life-cycle costs of steam generation in new central coal-fired facilities were shown to be lower than those for continued burning of fuel oil in existing boilers, when coal costs $30/ton ($1.41 Btu) and oil costs $3.16/million Btu. It is cost-effective to add extra facilities to cogenerate electric power along with steam in new coal-fired systems, compared to purchasing electricity at a price of $0.033 (33 mills) per kilowatt-hour, because ofthe low cost per unit of coal energy. High steam-transmission pressures (600 psia) lead to lower-cost piping systems than lower pressures (300 psia and 100 psia). Coal and waste haul costs are small compared to other system costs.

CONSERVATION

REFER ALSO TO CITATION(S) 20776, 20777, 20785, 20797, 20806, 20841, 20845, 20846

SUPPLY, DEMAND, AND FORECASTING

REFER ALSO TO CITATION(S) 20015, 20038, 20061, 20720, 20745, 20773, 20788, 20795, 20796, 20802, 20804

20734 (BNL—51093) **Use of the Reference Energy System and EEMIS to analyze some cause-effect relationships.** D'Acierno, J.; Hermelee, A. (Brookhaven National Lab., Upton, NY (USA)). Nov 1979. Contract EY-76-C-02-0016. 23p. Dep. NTIS, PC A02/MF A01.

The Energy Emergency Management Information System (EEMIS) and the Reference Energy System (RES) form an ideal framework for analyzing cause-effect relationships in the petroleum and natural gas energy systems. This report presents four case studies that demonstrate the applications of EEMIS and the RES for analyzing (1) the relationships between weather and the demand for energy in regions of the US, (2) the effect of a refinery outage on oil product distribution, (3) the impact of transportation outages on the flow and supply of petroleum, and (4) the relationship between income and energy usage.

20735 (BNL—51135) **Regional Issue Identification and Assessment program (RIIA). Environmental impacts and issues of the EIA MID-MID scenario: Federal Region I (New England).** Brainard, J.; Munson, J.S. (Brookhaven National Lab., Upton, NY (USA). National Center for Analysis of Energy Systems). 15 Apr 1979. Contract EY-76-C-02-0016. 64p. Dep. NTIS, PC A04/MF A01.

The impacts described here for 1985 and 1990 are based on a national energy projection which assumes medium energy demand and fuel supply through 1990 but does not incorporate the policies of the National Energy Act (NEA). This scenario, referred to as the Projection Series C or the TRENDLONG MID-MID scenario, is one of six possible energy futures developed by the DOE Energy Information Administration for the Department's 1977 Annual Report to Congress. It was chosen as representative of the official DOE national energy projections when this project was initiated, prior to the passage of the National Energy Act. Since the RIIA program is part of an ongoing review of the regional impact of energy policies, the next phase will examine the National Energy Act (NEA) and initiatives suggested by the President's second National Energy Plan. However, since coal utilization increases under the NEA, in general, impacts identified in the TRENDLONG Series C Scenario should provide a framework for the discussion of impacts by NEA. The environmental impacts discussed in this volume are for Federal Region I (Maine, Vermont, New Hampshire, Massachusetts, Rhode Island, and Connecticut). However, there are nine companion volumes, one for each of the other Federal Regions.

20736 (BNL—51136) **Regional Issue Identification and Assessment program (RIIA). Environmental impacts and issues of the EIA MID-MID scenario: Federal Region II (New York and New Jersey).** Brainard, J.; Munson, J.S. (Brookhaven National Lab., Upton, NY (USA). National Center for Analysis of Energy Systems). 1 May 1979. Contract EY-76-C-02-0016. 55p. Dep. NTIS, PC A04/MF A01.

The impacts described for 1985 and 1990 are based on a national energy projection (scenario) which assumes medium energy demand and fuel supply through 1990 but does not incorporate the policies of the National Energy Act (NEA). This scenario, referred to as the Projection Series C or the TRENDLONG MID-MID scenario, is one of six possible energy futures developed by the DOE Energy Information Administration for the Department's 1977 Annual Report to Congress. It was chosen as representative of the official DOE national energy projections when this project was initiated, prior to the passage of the National Energy Act. The environmental impacts discussed in this volume are for Federal Region II, comprising New York and New Jersey.

20737 (CONF-800345—1) **Energy data collection as a necessary activity for developing countries.** Loebl, A.S.; Cagle, J.D. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 30p. Dep. NTIS, PC A03/MF A01.

From Costa Rican workshop on energy and development; San Jose, Costa Rica (17 Mar 1980).

This paper examines the reasons for energy data collection by developing countries and includes an examination of the special requirements of Costa Rica for energy data collection. A primary reason for national data collection is to support the planning function, and this is particularly significant where energy planning and economic development are concerned. Energy data are necessary to support all phases of planning: short-term; mid-term; and long-range and/or strategic planning. These different planning requirements are discussed. Energy data are also necessary to support national management, as well as the economic-development functions. These latter requirements are also discussed briefly.

20738 (CONS—8155-T1) **Energy management, planning, and program development.** (Ohio State Government, Columbus (USA)). 1977. Contract EM-75-F-01-8155. 9p. Dep. NTIS, PC A02/MF A01.

The Ohio ERDA is statutorily required to maintain an energy-planning capability and to manage a programmatic effort to bring Ohio energy supply and demand into balance consistent with the state's growth and development needs. The Ohio Energy Information System is the major planning tool and it encompasses the Ohio Energy Data Base, the Energy Short-Term Emergency Evalution Model, and a capability to assess alternative-policy-action impacts. A discussion of the program is presented. (MCW)

20739 (DOE/EIA—0183/19) **Assessing the evidence for a low energy future: a critique of The Good News About Energy.** Briggs, B.J. (Department of Energy, Washington, DC (USA). Energy Information Administration). Feb 1980. 82p. Dep. NTIS, PC A05/MF A01.

Within the general theme of the use and effectiveness of mathematical models for energy-policy evaluation, this report highlights the need for critical review of the context within which models are employed. The report focuses specifically on the use of forecasting/modeling studies as references in The Good News About Energy, a Council on Environmental Quality (CEQ) report issued in 1979; this report discusses the potential for achieving a low-energy-growth future in the US and the national implications of such a future. The report concludes that a low energy future is technologically possible, economically sound, and environmentally attractive. The supporting studies cited in the CEQ report are described in terms of their methodologies, underlying assumptions, and output results. The studies represent a spectrum of forecasting/modeling approaches: technological assessments; a model-integrated approach; a general-equilibrium model; and a time-trend projection approach. A comparison of the studies also reveals diversity in their underlying assumptions. Macro-economic trends, association between energy consumption and GNP growth, roles of electricity use, penetration of new technologies, efficiency improvements in future consumption patterns, as well as the procedural questions such as base-case definition and input-output coefficients are major areas of disagreement between the studies. The inconsistencies in methodology, assumptions, and results cast doubt on CEQ's presentation of the studies as mutually supportive. A more general discussion of The

Good News About Energy emphasizes the need for technical proficiency and informed skepticism in the effective use of models for policy analysis.

20740 (DOE/IA—0001T/3(80)) **International energy indicators.** Bauer, E.K. (ed.). (Department of Energy, Washington, DC (USA)). Mar 1980. 30p. Dep. NTIS, PC A03/MF A01.

For the international sector, a table of data is first presented followed by corresponding graph of the data for the following: (1) Iran: crude oil capacity, production, and shut-in, 1974 to February 1980; (2) Saudi Arabia (same as Iran); (3) OPEC (ex-Iran and Saudi Arabia); capacity, production, and shut-in, 1974 to January 1980; (4) non-OPEC Free World and US production of crude oil, 1973 to January 1980; (5) oil stocks: Free World, US, Japan, and Europe (landed), 1973 to 1979; (6) petroleum consumption by industrial countries, 1973 to October 1979; (7) USSR crude oil production, 1974 to February 1980; (8) Free World and US nuclear generation capacity, 1973 to January 1980. For the United States, the same data format is used for the following: (a) US imports of crude oil and products 1973 to January 1980; (b) landed cost of Saudi Arabia crude oil in current and 1974 dollars, 1974 to October 1979; (c) US trade in coal, 1973 to 1979; (d) summary of US merchandise trade, 1976 to January 1980; and (e) US energy/GNP ratio (in 1972 dollars), 1947 to 1979.

20741 (EPRI-PS—79-5-LD) **Energy economic projections for the 1979 overview.** Cleary, L.D. (Electric Power Research Inst., Palo Alto, CA (USA)). Sep 1979. 130p. Dep. NTIS, PC A07/MF A01.

Each year the EPRI Planning Staff publishes an overview to the 5-year research and development program plan. This report elaborates on and documents key energy demand and supply, economic, and financial issues analyzed in the Overview and Strategy 1980-1984 Research and Development Program Plan, EPRI—1141-PS. The report begins with a summary and expansion of energy and economic issues presented in the planning factors section of the Overview keyed to ETA-MACRO and WEM results. It is followed by an alternative view on the benefits of R and D planning. Next, key assumptions used in the models are outlined. Finally, sensitivity cases explore the implications of a moratorium on the construction of new nuclear plants in the US. Copies of the ETA-MACRO computer input and output from the Overview scenarios are available. 21 references, 25 figures, 24 tables.

20742 (HNEI—80-02) **Energy self-sufficiency plan for County of Hawaii: energy-demand patterns and projections.** Hahn, Y.K. (Hawaii Univ., Manoa (USA). Hawaii Natural Energy Inst.). Jun 1979. Contract EM-76-F-01-8163. 89p. Dep. NTIS, PC A05/MF A01.

The primary purpose of this study is to obtain for the next decade until 1990, energy-demand forecasts for the County of Hawaii. To do so, however, requires first-hand knowledge on energy-use patterns of the island community. To accomplish this, the study first is devoted to the analysis of energy-use patterns, covering four years (1975-1978). The energy-use patterns are analyzed in terms of energy-supply sources, energy use by types, and by end users. The end users are broadly categorized into four categories: transportation, industrial, commercial, and residential sectors. Electrical generation is treated as a distinctive primary energy-using sector. For the sake of expediency, the transportation sector includes all means of mobility, including air transportation. This grouping also means automobile fuel used by private motorists, commercial bus fleet, and industrial fleet. Categorization of industrial, commercial, and residential sectors are adopted from customer categorization used by Hawaii Electric Light Company. The second part of the study takes on energy-demand projections by sectors identified above. Three projection levels (high, intermediate, and low) are made covering up to the year 2000. Assumptions made in each projection level are elaborated upon. 1977 is used as the base year since data available for 1978 were incomplete preliminary data.

20743 (SIB-D—12-1979) **Energy demand analysis: present structures and future changes in the Swedish households, service, and transportation sectors.** Saros, G. (Swedish Council for Building Research, Stockholm). 1979. 133p. Dep. NTIS, PC A07/MF A01.

This analysis of the energy demand is restricted to three sectors: household, service, and transportation. The study is divided into three parts. The first part deals with the present energy demand structure, where a comparative analysis is carried out of the present energy-consumption structure in Sweden, the United States and France. The two following parts are devoted to possible future changes in the energy demand structure. A sensitivity analysis of the future Swedish energy demand structure is carried out in the second part of this study with the help of a simulation model (the MEDEE-2 model), and an optimization model of studying the future energy demand in the household and service sectors is presented in the third part.

20744 Ricardian perspective on New England's alleged energy crisis. Weckstein, R. Waltham, MA; Brandeis University (1978). 21p. (NP—240400).

The accepted view that new England's energy problem is unique is dispelled. It is true that the cost in New England of a kWh of energy is higher than in the rest of the US. The cost of energy as a component of total manufacturing cost is still lower in New England than in most other states. The cost of energy per dollar of (value-added) output is 0.9 cent in Massachusetts and Vermont, 1 cent in Connecticut and Rhode Island, 1.5 cents in New Hampshire, and 3.2 cents in Maine. Other costs are 2.1 cents in Pennsylvania, 2.7 cents in Alabama, and 3.9 cents in Louisiana. In New England, the price of natural gas is being permitted to rise toward a price that would make oil products competitive with it. Gradually, prices of the diverse sources of energy will become economically consistent with one another. Then, New England will gain its peculiar advantage as a low-energy-intensive manufacturing region derived from a rise in the price of energy. The Ricardo effect, a most-vulnerable theorem in economics, is considered.

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 19916, 20014, 20565, 20723, 20730, 20746, 20753, 20787, 20799, 20859

20745 (DOE/EIA—0201/8) **Use of Federal lands for energy development. Energy policy study. Volume 8.** Porter, E. (Department of Energy, Washington, DC (USA). Energy Information Administration). Mar 1980. 125p. Dep. NTIS, PC A06/MF A01.

Assuming that domestic energy resources continue to be developed by the private sector, the government faces the policy problem of transferring Federal lands to private control in such a manner as to both promote the efficient development of the resource and secure the public a maximum share of the return from such development. A system of direct sale of such development rights at a rate and in an order determined by private demands is shown to satisfy both goals perfectly in a world without uncertainty or market imperfections. Either uncertainty or market imperfection will result in failure of such a scheme to achieve one or both goals, so that a variety of modified policy approaches have been devised. Each of these modifications is itself imperfect, however, and unless carefully matched to the specific imperfection characteristic of the result to which it is applied, may actually aggravate the shortfall from the efficiency or revenue goals. Review of existing Federal lands policy reveals a wide range of these approaches, with three general problems: (1) in certain instances, regulatory devices adopted are inappropriate as corrective devices for major market imperfections characteristic of the resource; (2) more generally, the devices adopted generate new distortions of the resource-development pattern potentially more serious than those being corrected; and finally, fragmentation of resource development authority in the Federal government sharply reduces prospects for existing programs to plausibly improve on either the efficiency or revenue consequences of a direct-sale approach.

FOSSIL FUELS

REFER ALSO TO CITATION(S) 20048

COAL

REFER ALSO TO CITATION(S) 19961, 20011, 20015, 20033, 20035, 20038, 20039, 20040, 20044, 20245, 20246, 20565, 20566, 20755

20746 Coal data book. Washington, DC; President's Commission on Coal (Feb 1980). 235p. (NP—24387). GPO $6.50.

Coal Data Book is a data compilation on coal production and consumption assembled by the President's Commission on Coal (Historical trends and forecasts to 1985 and 1990). The President's Commission on Coal was established by Executive Order on May 26, 1978 and ended on March 15, 1980. The Commission conducted a comprehensive and independent review of the coal industry with particular emphasis on four areas: the future of the coal industry, labor-management relations, living conditions of coal miners, and the effects of government regulations on the production and utilization of coal. Other publications issued by the Commission and available through the US Government Printing Office are: The Americal Coal Miner, an illustrated book on living conditions of coal miners and their families, and Recommendations and Summary Findings of The President's Commission on Coal, the Commission's final report to President Carter.

20747 Appalachian coal: supply and demand. Lin, W.W. pp 95-117 of Econometric studies in energy demand and supply. Maddala, G.S.; Chern, W.S.; Gill, G.S. (eds.). New York, NY; Praeger Publishers (1978).

This chapter addresses the estimation of the effects of strip mining legislation on coal supply and mining employment in Appalachia. This study is a good illustration of the use of a linear-programming model and engineering data to derive supply functions. Lin finds that the economic impact of legislation is considerably smaller than the casual estimates that have previously been suggested by policy makers. This study illustrates the importance of careful analysis of available data as an input to policy decision making.

PETROLEUM

REFER ALSO TO CITATION(S) 20056, 20059, 20060, 20061, 20062, 20066, 20740

20748 (DOE/EIA—0183/18) **Econometric model of the market for residual fuel oil on the East Coast. Technical report.** Hewlett, J.G. (Department of Energy, Washington, DC (USA). Energy Information Administration). Mar 1980. 74p. Dep. NTIS, PC A04/MF A01.

The Impacts of the Entitlements Program on the Market for Residual Fuel Oil on the East Coast, Analysis Report AR/EI/80-6 reports the impacts of the Entitlements Program on supply, market price, and quantity of residual fuel oil. This report presents the theoretical derivation of the model used to derive these impacts. A discussion of a number of econometric issues, including the Full Information Maximum-Likelihood technique which is used to estimate the model, is also presented.

NATURAL GAS

REFER ALSO TO CITATION(S) 20059, 20061, 20062, 20066, 20777

OIL SHALES AND TAR SANDS

REFER ALSO TO CITATION(S) 20094

HYDROGEN AND SYNTHETIC FUELS

REFER ALSO TO CITATION(S) 20245, 20246

ELECTRIC POWER

REFER ALSO TO CITATION(S) 20337, 20525, 20526, 20527, 20528, 20720, 20741, 20764, 20777, 20796

20749 (DOE/RA/08137—T1(App.1)) **Power plant performance analysis and guidelines study. Appendix I. Recommended guideline for siting power plants.** Keller, R.W.; Bhatla, A.; Smith, M.J. (System Development Corp., Santa Monica, CA (USA)). Jun 1978. Contract FC01-77RA08137. 18p. Dep. NTIS, PC A02/MF A01.

This initial guideline is issued to describe and make available to the public methods acceptable to the California Energy Commission staff of implementing specific parts of the Commission's regulations and provide guidance to applicants desiring to site new power plants in the State of California. Information is included on establishing the most cost-effective levels or ranges of reliability and efficiency and on applicants actions to ensure the achievement of established reliability and efficiency levels and ranges. (LCL)

20750 (NP—25581) **Electric Utility Rate Design Study: an evaluation of reconciliation procedures for the design of marginal-cost-based time-of-use rates.** (Gordian Associates, Inc., New York (USA); Electric Power Research Inst., Palo Alto, CA (USA)). 7 Nov 1979. 132p. EPRI, Palo Alto, CA.

The primary justification for pricing electricity at marginal cost is that this will further the goal of economic efficiency. This premise is based on the argument that if consumers are charged the costs to society of the economic resources needed to provide them with additional electricity, they will individually make economically rational trade-offs between the consumption of electricity and the purchase of other goods. The aggregate of these decisions can be shown to result in an optimal allocation of scarce resources if the marginal requirements for efficient resource allocation are met elsewhere in the economy. This report does not address the question as to whether marginal costs are appropriate for use in developing electric-utility rates. It takes as a given that marginal costs are to be used as the starting point for the design of time-of-use (TOU) rates. This, in turn, implies that economic efficiency is considered to be an important goal of rate-making. This study reviews and evaluates a number of methods that have already been proposed for reconciling the difference between revenues with rates set at marginal costs and those revenues that would result from the prescribed accounting procedures. It addresses two distinct but related reconciliation problems. The first relates to how the overall revenue difference is spread across customer classes, while the second relates to how marginal costs are used to design rates that match the revenue target for each class.

20751 (NP—25582) **Electric Utility Rate Design Study: a procedure for developing electric-utility rates based upon time-differentiated accounting costs.** (Putnam, Hayes and Bartlett, Inc., Newton, MA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). 26 Nov 1979. 204p. EPRI, Palo Alto, CA.

After more than two years of intensive effort, Phase I of the Electric Utility Rate Design Study observed that the procedures for time-differentiated costing using accounting costs need further logical development and documentation. As part of a continuing research effort in Phase II, Putnam, Hayes and Bartlett, Inc. (PHB) was assigned to develop a methodological framework for rates based upon time-differentiated accounting costs. This report provides documentation of that research effort. After a brief introduction, the next six sections of the report focus upon the specification and application of each step of the methodology to Virginia Electric and Power Company (VEPCO) and Ontario Hydro (HYDRO). Given that time-differentiated rates based upon both marginal and accounting costs have been developed in Phase I, the VEPCO case study provides an opportunity for a direct comparison of alternative methodologies. The HYDRO case study provides a useful contrast. HYDRO is a winter-peaking, bulk-power, publicly-owned utility system with significant generation from hydro facilities. VEPCO, on the other hand, is a summer-peaking, investor-owned wholesale and retail utility system with predominantly fossil-fired generation. In general, rates based upon time-differentiated accounting costs meet Bonbright's criteria for a sound rate structure. PHB concludes that the gradual transition from existing rate structures to time-differentiated ones can be accomplished without a concurrent shift from accounting costs to marginal costs.

20752 (NP—25583) **Electric Utility Rate Design Study: a review and evaluation of methods for selecting rating periods.** (Gordian Associates, Inc., New York (USA); Electric Power Research Inst., Palo Alto, CA (USA)). 8 Feb 1980. 127p. EPRI, Palo Alto, CA.

This report provides a review and evaluation of four different methods used in the selection of rating periods for time-of-use rates. Generally referred to by their developers' names, the four methods are: Ebasco Services, Inc. ; National Economic Research Associates, Inc.; Ontario Hydro; and Long Island Lighting Co. Multiple objectives, some of which are not compatible, have been claimed for time-of-use rates (e.g., economic efficiency, energy conservation, preservation of the environment). Thus, a time-of-use rate structure designed to achieve one objective may not satisfy other objectives. This study does not address which of these possible objectives is best, since such decisions are highly subjective and require data that are generally not available. Rather, the report evaluates each of the methods against a set of criteria that must be satisfied if the method is to be useful in a regulated environment. Each of the methods reviewed here claims to select rating periods that reflect variations in cost (along with other considerations). In practice, however, these methods differ more in their development of underlying costs, than they do in their general approach towards selecting rating periods. Accordingly, where necessary, the methodologies used to allocate or compute time-differentiated demand and energy costs are outlined and analyzed.

20753 **Politics of energy policy: regulation of electric utility rate structure design by the Public Service Commission of Wisconsin.** Akridge, P.B. Madison, Wisconsin; Univ. of Wisconsin (1979). 545p. University Microfilms Order No. 80-01,121.

Thesis (Ph. D.).

The seminal national test-case of 1972 to 1974 (Re. Madison Gas and Electric Company) which resulted in the revision of the traditional declining block rate structure and the adoption of the time-of-use/peak-load pricing rate design is investigated. Chapter I briefly reviews the history of utilities regulation in Wisconsin and establish the analytical frameworks, research hypotheses, and methodology used in the study. Chapter II describes the electric utility rate-making process of which rate structure design is a part. To better understand the politics involved, a typology of the affected interest groups and some of their concerns in this regulatory process is presented. In Chapter III and IV the PSCW rate case is examined in detail - according to the two analytical approaches adopted. It was found that, contrary to expectations, environmentalist public-interest groups participated quite effectively during the proceedings and, along with the utilities and other business interests, significantly affected the outcome. The subgroup of low-income residential consumers, on the other hand, clearly supported expectations. Poor residential consumers did not effectively participate - either directly or indirectly. Moreover, characteristics of the PSCW regulatory process did indeed serve as institutionalized biases against poor electricity consumers and contributed to nondecision-making (i.e. limiting the scope of decision-making to certain safe issues). Chapter V concludes the study with a discussion of the research, theoretical, and policy implications. Here, the meaningfulness of the study

within the broader contexts of future research in this energy policy area, political science theory, and responsible public policy is explored.

20754 Empirical tests of the Averch-Johnson hypothesis: a critical appraisal. Zimmer, M.A. pp 152-171 of Econometric studies in energy demand and supply. Maddala, G.S.; Chern, W.S.; Gill, G.S. (eds.). New York, NY; Praeger Publishers (1978).

During recent years there have been many empirical studies on the effectiveness of rate-of-return regulation in the electric-utility industry. This chapter examines critically these empirical studies. Sections of the chapter review the well-known Averch-Johnson hypothesis, the work on empirical tests of this hypothesis, and the measures of rental price of capital used in these studies. Since the cost of capital plays a fundamental role in the analysis of regulation, the rental price of capital is a crucial variable in the analysis. It is argued that the empirical studies on regulation have neglected this issue and used a variety of proxy measures. A final section discusses the empirical methodologies and econometric specification in these studies.

ELECTRIC POWER GENERATION

REFER ALSO TO CITATION(S) 20529, 20567, 20568, 20569, 20570, 20571

20755 Estimation of optimal inventory of coal stocks held by electric utilities. Roberts, R.B. pp 118-139 of Econometric studies in energy demand and supply. Maddala, G.S.; Chern, W.S.; Gill, G.S. (eds.). New York, NY; Praeger Publishers (1978).

In this chapter, the author tries to explain the wide fluctuations in inventories of coal stocks held by electric utilities. The chapter develops a theoretical model of cost minimization under uncertainty for electric utilities holding coal stocks. The model, interestingly enough, results in a switching regression model with endogenous switching. It is shown that the observed data points lie on the marginal-cost curve or a constrained curve, depending on the value of a criterion function. Though the estimation of this switching model is theoretically possible, the available data precluded such an attempt and Roberts used the usual regression models (correcting for serial correlation in the residuals). He found the predictions obtained by these methods quite satisfactory.

20756 Omitted cross-sectional effects in measurement of economies of scale in electricity generation. Gill, G.S. pp 140-151 of Econometric studies in energy demand and supply. Maddala, G.S.; Chern, W.S.; Gill, G.S. (eds.). New York, NY; Praeger Publishers (1978).

Some evidence on the issue of economies of scale in electricity generation on the basis of cost data for recent years is presented. The study estimates elasticities of fuel input, labor input, and production expenses with respect to output. The separate estimation of input demand function is justified if a fixed-coefficients model is assumed as Komiya has done (Rev. Economics and Statistics, pp 156-66, May 1962). The results indicate that there are almost no economies of scale in the use of fuel input and that there are substantial economies of scale in the use of labor input. The study also analyzes data on equipment costs for additions of equipment made during the 1952-1972 period.

CONSUMPTION AND UTILIZATION

REFER ALSO TO CITATION(S) 20721, 20806, 20816

UNCONVENTIONAL SOURCES AND POWER GENERATION

REFER ALSO TO CITATION(S) 20590, 20845

SOLAR

REFER ALSO TO CITATION(S) 20253, 20271, 20272, 20360, 20367, 20374, 20381, 20383, 20431

GEOTHERMAL

REFER ALSO TO CITATION(S) 20476, 20482

ENERGY CONVERSION

MHD GENERATORS

DESIGN AND DEVELOPMENT

20757 (FE—2246-10) Testing and evaluation of MHD materials and substructures. Quarterly technical progress report, October-December 1978. Murphree, D.L.; Bauman, L.E.; Bell, C.J.; Benton, R.D.; Coleman, H.W.; Malloy, T.B.; Nail, J.B.; Powe, R.E.; Shepard, W.S.; Wehr, A.G. (Mississippi State Univ., Mississippi State (USA). Energy Research Center). Jan 1979. Contract EX-76-C-01-2246. 44p. Dep. NTIS, PC A03/MF A01.

Mississippi State University's MHD research group has constructed a Test Stand that can simulate the environment in any of the various substructures of the coal-fired baseline MHD power plant. The Test Stand has been successfully operated under total computer control with air heating and oil combustion. A series of short-term shakedown tests has been performed and the Test Stand is now being operated, with slag injection, for longer durations of time in order to deposit the slag throughout the system and especially on the annular boiler walls, and also to eliminate any bugs in the systems that would cause a shutdown during long-term operation. After this preliminary testing has been completed, the Test Stand will be utilized to simulate the gas-slag-seed stream and gas-side temperature conditions that will be present in the baseline plant's radiant boiler. Thermal and gas chemistry modeling work has been continued in order to develop comprehensive programs that will predict the properties of the gas-slag-seed stream, the heat transfer characteristics, and the performance of the Test Stand, annular boiler and the radiant furnace test section. The Test Stand and annular boiler have been constructed, and a major effort for this quarter has been to increase the operational time for the test runs. Efforts have also been concentrated on improving the mixing of the seed and the slag with the hot combustion gas stream. A water-cooled condensation probe, an air-cooled materials testing probe, and gas sampling and analysis equipment are being readied for use with long-term runs, along with such diagnostic instruments as a sodium line reversal unit, a laser transmissometer, and a laser doppler velocimetry system.

MATERIALS, COMPONENTS, AND AUXILIARIES

20758 Ceramic components for MHD electrode. Marchant, D.D. US Patent Application 035,158. [nd]. 13p.

A ceramic component which exhibits electrical conductivity down to near room temperatures has the formula: Hf/sub x/In/sub y/A/sub z/O_2 where x = 0.1 to 0.4, y = 0.3 to 0.6, z = 0.1 to 0.4 and A is a lanthanide rare earth or yttrium. The component is suitable for use in the fabrication of MHD electrodes or as the current leadout portion of a composite electrode with other ceramic components.

20759 (FE—2476-T1) Gaseous electrode development. Quarterly progress report, July 1-September 30, 1979. (Reynolds Metals Co., Sheffield, AL (USA). Energy Conversion Div.). 6 Nov 1979. Contract EX-76-C-01-2476. 35p. Dep. NTIS, PC A03/MF A01.

The main goal in this project is to demonstrate the feasibility of using gaseous electrodes in an MHD channel and to determine the optimum condition for their operations. Previous work on this program has established that, to meet such an objective, the gaseous electrodes must be designed using plasma sources that operate continuously and which show a promise of operating successfully in an MHD channel environment. A new approach to the gaseous electrode concept that appears to hold a high probability of success and has various options for implementation uses microwave generated plasma sources. The following tasks were set for this quarter: (A) make a study of possible approaches for implementation of the microwave gaseous electrode (MGE) concept in the MHD channel; (B) procure microwave hardware; design and fabricate bench scale model of microwave plasma torch; also commence design of MHD window frame for Model I of MGE; (C) improve combustor performance; and (D) upgrade instrumentation capability of facility. Progress is reported. (WHK)

20760 (FE—15529-4) MHD electrode development. Quarterly report, July-September 30, 1979. Sadler, J.W.; Bein, J.; Black, D.L. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Advanced Energy Systems Div.). Oct 1979. Contract AC01-79ET15529. 115p. Dep. NTIS, PC A06/MF A01.

A fused cast spinel, $MgAl_2O_4$, has been evaluated for its corrosion resistance in western slag. The spinel appears to be insignificantly affected by the corrosive nature of the slag and based on this performance will be subjected to further testing. Results of thermal conductivity measurements of a number of hafnia and zirconia based electrode materials, to be run in the upcoming WESTF Test 42, are reported. Laboratory electrochemical screening tests have continued. Results are presented for iron cathodes and plati-

num anodes in western slag. Results from additional electrochemical polarization tests have shown the desirability of modifying the test cell to improve test reproducibility. A summary of available data covering electrode durability has been prepared covering laboratory electrochemical and generator tests for various MHD environments. Emphasis has been placed in refractory electrode materials. The status of various design activities, including design of the Materials Test Section (MTS), the modified WESTF test section, and various WESTF test design activities, are presented. Results of post-test analysis activities for WESTF Test 41 - Run 2 and WESTF Test D-9 are presented.

20761 (PNL-SA—7522) **Rare-earth hafnium oxide materials for magnetohydrodynamic (MHD) generator application.** Marchant, D.D; Bates, J.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1979. Contract EY-76-C-06-1830. 7p. (CONF-790641—12). Dep. NTIS, PC A02/MF A01.

From Rare earth research conference; Fargo, ND, USA (25 Jun 1979).

Several ceramic materials based on rare-earth hafnium oxides have been identified as potential high-temperature electrodes and low-temperature current leadouts for open cycle coal-fired MHD generator channels. The electrode-current leadouts combination must operate at temperatures between 400 and 2000K with an electrical conductivity greater than 10^{-2} ohm^{-1} cm^{-1}. The electrodes will be exposed to flowing (linear flow rates up to 100 m/s) potassium seeded coal combustion gases (plasma core temperatures between 2400 to 3200°K) and coal slag. During operation the electrodes must conduct direct electric current at densities near 1.5 amp/cm^2. Consequently, the electrodes must be resistant to electrochemical decompositions and interactions with both the coal slag and potassium salts (e.g., K_2SO_4, K_2CO_3). The current leadout materials are placed between the hot electrodes and the water-cooled copper structural members and must have electrical conductivities greater than 10^{-2} ohm^{-1} cm^{-1} between 1400 and 400°K. The current leadouts must be thermally and electrochemically compatible with the electrode, copper, and potassium salts. Ideally, the electrodes and current leadouts should exhibit minimal ionic conductivity. The fabrication, electrical conductivity, and electrochemical corrosion of rare-earth hafnium oxide materials are discussed. (WHK)

20762 **Ceramic component for electrodes.** Marchant, D.D. (to Dept. of Energy). US Patent 4,180,484. 25 Dec 1979. Filed date 14 Jun 1978. 6p.

PAT-APPL-915,419.

A ceramic component suitable for preparing MHD generator electrodes consists of HfO_2 and sufficient Tb_4O_7 to stabilize at least 60 volume percent of the HfO_2 into the cubic structure. The ceramic component may also contain a small amount of PrO_2, Yb_2O_3 or a mixture of both to improve stability and electronic conductivity of the electrode. The component is highly resistant to corrosion by molten potassium seed and molten coal slag in the MHD fluid and exhibits both ionic and electronic conductivity. 6 claims.

THERMOELECTRIC GENERATORS

20763 (AD-A—075609) **Militarized thermoelectric power sources. Technical report.** Guazzoni, G.; Herchakowski, A.; Angello, J. (Army Electronics Research and Development Command, Fort Monmouth, NJ (USA). Electronics Technology/Devices Lab.). Jul 1979. 9p. NTIS, PC A02/MF A01.

Thermoelectric power sources are being developed to provide multifuel, silent, maintenance free tactical power generators for forward area applications. Recent technology improvements, state of development, and performance characteristics of the 100-Watt and 500-Watt Thermoelectric Power Sources are presented.

MATERIALS, COMPONENTS, AND AUXILIARIES

REFER ALSO TO CITATION(S) 20884

FUEL CELLS

20764 **Fuel-cell power plants.** Fickett, A.P. (Electric Power Research Inst., Palo Alto, CA). *Sci. Am.;* **239**: No. 6, 70-76(Dec 1978).

A fuel cell converts the chemical energy of a fuel into electricity directly, with no intermediate combustion cycle. It is now viewed by the electric power industry in the US as an important alternative for meeting the load growth expected over the next two decades, doing so in an environmentally acceptable way and saving fuel. The cost and the efficiency of the total power plant are to a large extent governed by the performance of the individual cell. Promising results have been established but there are problems, mainly those involving structural changes that take place in the electrolyte over long periods of operation. At present these problems limit the endurance and reliability of the cells. The best estimate of the capital cost of a molten-carbonate power plant in mass production is $350 per kWh (in 1980 dollars). The benefits the fuel cell offer the utility industry and society at large will be realized only after it attains commercial scale. (MCW)

DESIGN AND DEVELOPMENT

20765 **Battery unit, containing one or more fuel-cell blocks.** van Linden, J. (to Electrochemische Energieconversie, N.V.). US Patent 4,176,213. 27 Nov 1979. Priority date 29 Jun 1977, Belgium, 8p.

A fuel-cell battery unit contaning a number of fuel-cell blocks is described. The fuel-cell blocks are attached to a beam having an I-shaped cross-section, on both sides against the thin intermediate section thereof. Primary ducts for supplying air, fuel, and electrolyte are provided either in the wide top and bottom parts of the beam, or separately alongside the beam. From these primary ducts secondary tubes are provided to supply or discharge air, fuel, and electrolyte to or from the fuel-cell blocks. A number of such units can be stacked to form a battery or battery section.

PERFORMANCE AND TESTING

REFER ALSO TO CITATION(S) 20770

20766 **Determination of the ohmic losses in oxygen electrode pores of the fuel cells based on the galvanostatic charge curves.** Golin, Yu.L.; Golina, G.E.; Pakulina, O.N.; Rylova, G.V.; Sherstobitov, Yu.S. *Elektrokhimiya;* **14**: No. 1, 27-32(Jan 1978). (In Russian).

A preliminary analysis is presented on the experimental data obtained in the process of investigating the cathodes of hydrogen-oxygen fuel cells with circulating liquid alkali electrolyte. The methodology of the determination of ohmic losses in the oxygen electrode pores was analyzed by a method based on the curve of polarization increase observed after switching on a nominal density current. In this case the unfolding curve is selected from the characteristic time t which is determined from specific surface values of the electrode and electrolyte resistance. By extrapolating to zero, the total value of the ohmic losses can be obtained. This value exceeds the losses of an ideal electrode by 15 to 20%; it relates only weakly to the current density and increases with the aging of an electrode. This value is very strongly associated with the gas permeability coefficient and it decreases during reductive thermal treatment of the electrode.

MATERIALS, COMPONENTS, AND AUXILIARIES

REFER ALSO TO CITATION(S) 20987

20767 **Fuel cell oxygen electrode.** Shanks, H.R.; Bevolo, A.J.; Danielson, G.C.; Weber, M.F. US Patent Application 018,211. [nd]. 10p.

An oxygen electrode for a fuel cell utilizing an acid electrolyte has a substrate of an alkali metal tungsten bronze of the formula: A/sub x/WO_3 where A is an alkali metal and x is at least 0.2, which is covered with a thin layer of platinum tungsten bronze of the formula: Pt/sub y/WO_3 where y is at least 0.8.

20768 (AD-A—072864) **On the properties of a fuel cell electrolyte. Final report 10 Jul 1978-15 Jan 1979.** Foley, R.T. (American Univ., Washington, DC). Feb 1979. Contract DAAK70-78-C-0128. 123p. NTIS, PC A06/MF A01.

The field of fuel cell electrolytes is surveyed with the objective of learning the deficiencies and good properties of the available systems. The survey included a study of inorganic acids as phosphoric, sulfuric, hydrochloric, perchloric, hydrofluoric and other strong acids; organic acids including sulfonic and carboxylic; alkaline systems; ion exchange membrane systems, solid electrolytes; and molten carbonate systems. Some general and specific conclusions are listed indicating the technical questions to be answered to develop a low temperature organic sulfonic acid system.

20769 (AD-A—075372) **Optimization of Pt-doped Kocite (trade name) electrodes in H_3PO_4 fuel cells. Final technical report, September 1978-May 1979.** Welsh, L.B.; Leyerle, R.W. (UOP, Inc., Des Plaines, IL (USA). Corporate Research Center). Aug 1979. Contract DAAG53-76-C-0014. 73p. NTIS, PC A04/MF A01.

The use of UOP Inc. Kocite (R*)-derived electrocatlysts as low-cost air and/or fuel electrocatalysts in phosphoric acid electrolyte fuel cells has been optimized with respect to some of the electrocatlyst and electrode structure parameters. Kocite-derived electrocatalysts are made from Kocite R* materials, which are composite structures consisting of pyropolymers chemically bonded to refractory substrates. Fuel cell electrodes are fabricated from these electrocatalysts and normally tested as anodes and cathodes in model fuel cells.

20770 (BNL—51053) **Fuel cell applied research: electrocatalysis and materials. Quarterly report, July 1-September 30, 1978.** Srinivasan, S.; Isaacs, H.S.; O'Grady, W.E.; Olender, H.; Olmer, L.J.; Daube, K.; Kordesch, K.V. (Brookhaven National Lab., Upton, NY (USA)). Jun 1979. Contract EY-76-C-02-0016. 30p. Dep. NTIS, PC A03/MF A01.

A study was undertaken to investigate the electrocatalysis of the formic acid and methanol oxidation reactions at underpotentially deposited metal surfaces at 25°C. The test electrode was a smooth polycrystalline platinum disc, on which a metal Bi, Cd, Pb or Tl was underpotentially deposited (UPD) by potential cycling in 1 N $HClO_4$. The organic reactant (HCOOH or CH_3OH) was added to this electrolyte so that its concentration was 0.26 M. Cyclic voltammograms were recorded on the Pt (control) and on the UPD test electrodes at a sweep rate of 50 mV/sec in the potential range of 0 to 1.45 V/RHE. Results are reported. Also, overpotentials in solid electrolyte fuel cells were studied. Alternating and direct current techniques were used to determine the impedance characteristics at the platinum-yttria stabilized zirconia (YSZ) interface in the regions of potentials where the oxygen evolution and reduction reactions take place. The measurements were conducted as a function of time to elucidate aging effects on the kinetics of these reactions. Experiments were conducted at 1000°C in the potential range of -600 to +600 mV vs an air reference electrode. Results are presented and discussed. (WHK)

20771 **Electrochemical cell and separator plate thereof.** Baker, B.S.; Dharia, D.J. (to Energy Research Corp.). US Patent 4,169,917. 2 Oct 1979. Filed date 10 Jul 1978. 6p.

A fuel cell includes a separator plate having first and second flow channels extending therethrough contiguously with an electrode and respectively in flow communication with the cell electrolyte and in flow isolation with respect to such electrolyte. In fuel cell system arrangement, the diverse type channels are supplied in common with process gas for thermal control purposes. The separator plate is readily formed by corrugation of integral sheet material. 11 claims.

APPLICATIONS

REFER ALSO TO CITATION(S) 20352

20772 (LA-UR—80-816) **Fuel-cell-powered golf cart.** Bobbett, R.E.; McCormick, J.B.; Lynn, D.K.; Kerwin, W.J.; Derouin, C.R.; Salazar, P.H. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 25p. (CONF-800523—1). Dep. NTIS, PC A02/MF A01.

From 3. international electric vehicle exposition and conference; St. Louis, MO, USA (May 1980).

The implementation of a battery/fuel-cell-powered golf cart test bed designed to verify computer simulations and to gain operational experience with a fuel cell in a vehicular environment is described. A technically untrained driver can easily operate the golf cart because the motor and fuel cell controllers automatically sense and execute the appropriate on/off sequencing. A voltage imbalance circuit and a throttle compress circuit were developed that are directly applicable to electric vehicles in general.

ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

REFER ALSO TO CITATION(S) 20252, 20742

20773 **Econometric studies in energy demand and supply.** Maddala, G.S.; Chern, W.S.; Gill, G.S. (eds.). New York, NY; Praeger Publishers (1978). 185p.

A separate abstract was prepared for each of 7 chapters in the book. One chapter, Growth of Electric Heating in the TVA Area, by G.S. Gill, G.S. Maddala, and S.M. Cohn, previously appeared in EAPA 4:349.

BUILDINGS

REFER ALSO TO CITATION(S) 20377, 20385, 20389, 20394, 20403, 20404

20774 (AD-A—075140) **Ceiling fans for energy conservation. Final report.** Story, G.T. (Army Facilities Engineering Support Agency, Fort Belvoir, VA (USA). Technology Support Div.). 16 May 1979. 14p. NTIS, PC A02/MF A01.

Considerations for the use of ceiling fans to conserve energy are given. A sample calculation of energy savings is included.

20775 (CONF-781235—P1, pp 91-93) **High performance structures: thin shell concrete foam domes.** Zimmerman, J. (Community Architects, Inc., Boulder, CO). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

20776 (DOE/CS—0149) **Status of the weatherization assistance program annual report for 1979.** (Department of Energy, Washington, DC (USA)). Feb 1980. 39p. Dep. NTIS, PC A03/MF A01.

The DOE Weatherization Assistance Program is the major provider of Federal weatherization assistance. The status report concentrates on the three areas of concern relating to weatherization activities: the extent of progress being made toward achievement of national energy conservation goals; the adequacy and costs of materials; and the need for and desirability of modifying weatherization activities (and any changes to the legislation necessary to accomplish these modifications), and of extending such activities to a broader range of income groups. Other programs in the FmHA, HUD, and HEW are discussed for their historic importance or their present or potential contribution to weatherization activities.

20777 (EPRI-EA—1312-SR) **Electricity and gas: issues in comparing the options using uncertain estimates.** Greenberger, M. (Greenberger (Martin), Washington, DC (USA)). Jan 1980. 91p. Dep. NTIS, PC A05/MF A01.

National concern about primary energy efficiency raises the question of whether government should try to induce consumers to select one energy form over another in energy uses where they now have a choice. When their options are restricted, consumers suffer a loss that is not accounted for by comparisons of energy efficiencies. A number of studies have asked whether it is better to convert coal to electricity or to gas in residential space-conditioning applications. As a group, these studies are inconclusive and subject to major uncertainties. Close examination of the studies reveals lack of agreement on terms and procedures of analysis, incongruent assumptions, and partisan advocacy. The country needs to support both electric and gas space-conditioning options. Maintaining consumer flexibility stimulates competition and promotes technological improvement. It also provides a hedge in the face of future uncertainties. Combined government-industry effort could help to identify the uncertainties, reduce their size, and establish a common set of consistent assumptions for making cost and efficiency calculations. Methods for making these calculations using uncertain estimates are outlined and illustrated in this report. 118 references, 7 figures, 8 tables, 55 notes.

20778 (K/CSD/INF—79/19) **Numerical modeling of the heat transfer and circulation in a ventilated room.** Tunstall, J.N. (Union Carbide Corp., Oak Ridge, TN (USA). Nuclear Div.). 1979. Contract W-7405-ENG-26. 29p. (CONF-7910139—1). Dep. NTIS, PC A03/MF A01.

From ACM mid-southeast chapter fall meeting; Gatlinburg, TN, USA (12 Oct 1979).

A computational technique to simulate the fluid dynamics and heat transfer for incompressible flows that are almost three-dimensional is being developed. Based on an extension of P.I. Nakayama's model, the technique employs an extension of the Simplified Marker and Cell (SMAC) technique. The basics of the model are discussed. Calculations of the circulation induced by a hot water heater in a ventilated room are presented to illustrate the characteristics of the technique.

20779 (LA—8282-MS) **Room weighting factors calculated from resistance-capacitance networks.** Kerrisk, J.F. (Los Alamos Scientific Lab., NM (USA)). Mar 1980. Contract W-7405-ENG-36. 30p. Dep. NTIS, PC A03/MF A01.

A new technique has been developed for calculating room weighting factors used in building energy analyses. A resistance-capacitance network model of the thermal behavior of a room is solved numerically. Simple circuit elements representing components such as walls, furniture, and room air are interconnected by convective or radiative heat flow paths to form the network. Methods for calculating values of the circuit parameters from wall response factors and other information are given. The main advantage of this technique is that the weighting factors determined are specific to the room described by the network. Weighting factors for a single-room building, dominated by direct-gain solar input, have been calculated as an example of an application of the technique.

20780 (LBL—9307) **Energy efficient window system. Final report.** (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1977. Contract W-7405-ENG-48. 156p. Dep. NTIS, PC A08/MF A01.

A transparent heat reflective coating called Heat Mirror was developed and tested and methods of controlling solar heat gain were investigated. The heat reflector has been successfully developed to the pre-production stage. The device cuts down overall heat loss through a single pane window by a significant factor. Solar gain is not greatly inhibited, nor is vision through the window impaired. The production feasibility study has been a success, but further work

is in progress to reduce costs and to improve the abrasion and corrosion resistance of the Heat Mirror. A thermally responsive solar control layer, called an Optical Shutter, was investigated, but results indicate that it did not warrant further pursuit in a retrofit application. The shutter was excluded and the basic invention was modified and the Superpane resulted. It is a window retrofit based on the combination of a Heat Mirror and a dead air space, found to be a viable concept. The device is described.

20781 (ORNL/TM—7266) **Experimental study of thermal resistance values (R-values) of low-density mineral-fiber building insulation batts commercially available in 1977.** Tye, R.P.; Desjarlais, A.O.; Yarbrough, D.W.; McElroy, D.L. (Dynatech R/D Co., Cambridge, MA (USA); Oak Ridge National Lab., TN (USA)). Apr 1980. Contract W-7405-ENG-26. 134p. Dep. NTIS, PC A07/MF A01.

This study was initiated in June 1977 to obtain and evaluate full-thickness thermal performance data on mineral fiber, i.e., fiberglass and rock wool, batt-type insulations. The study aimed to obtain full-thickness thermal performance data and to assess other properties of mineral fiber building insulations. The physical property measurements discussed in this report provide a measure of the range of values for density, thickness, and R-value based on a sampling of low-density mineral-fiber building insulation batts purchased in the marketplace in 1977. The experimental data were used to establish mean R-values at nominal (label) thickness of R-11 and R-19 fiberglass batts and R-11 rock wool batts. The full-thickness and sliced testing techniques provided a set of R-values on the purchased samples that were converted to R-values at label thickness by using a particular correlation of apparent thermal conductivity and density. The full thickness results indicate surprisingly large percentages below labeled R-value for these four types of mineral fiber insulation. A statistical analysis of these data based on the assumption of normally distributed properties is included. This yielded estimates of similar magnitude for the population from which the samples were purchased. An urgency for continued sampling and further testing of mineral fiber insulations by many laboratories was identified. The differences between results obtained with the sliced technique and results obtained with full-thickness testing must be thoroughly understood and documented so that adjustment factors for the thickness effect can be accurately established. (LCL)

20782 (PB—80-101181) **Publications numerical register, 1977-1978 (of the Swedish Council for Building Research).** (Swedish Council for Building Research, Stockholm). 1979. 41p. NTIS, PC A03/MF A01.

The Swedish Council for Building Research sponsors research and development work on physical planning, building design, building materials and structures, the use and management of buildings and energy conservation in the built environment. The results of the research work are published by the Council in one of the following Building Research Publication Series: R--research reports in Swedish; D--documents, research reports in other languages than Swedish, generally English; T--special publications, generally in Swedish; G--general information material in Swedish or English, such as activity plans, research programmes, lists of publication, project lists etc.; B--information sheets in Swedish; and S--summaries - detailed summaries in English of selected research reports.

20783 (PB—80-101199) **Current projects, 1978 (of the Swedish Council for Building Research).** (Swedish Council for Building Research, Stockholm). 1979. 56p. NTIS, PC A04/MF A01.

The Swedish Council for Building Research is the central agency in Sweden for the promotion, programming and financing of research into building and urban planning. This publication lists building research projects in progress in December 1978, including those of the National Swedish Institute for Building Research. Recently terminated projects are also included. In addition to the project title, researcher and affiliation, the total grant awarded is also given. The following are the main topic areas of research: Energy conservation in buildings; RandD on urban and regional planning with particular reference to local authority planning; RandD on the planning, construction and management of the built environment; Basic RandD.

20784 (PB—80-102031) **Illinois energy consumption 1963-1977.** Hill, L.; Biermann, W. (Illinois Dept. of Business and Economic Development, Springfield (USA). Office of Research). Jun 1979. 40p. NTIS, PC A03/MF A01.

This report contains current and historical Illinois energy consumption data by consuming sector and fuel type. It also contains detailed description of mapping techniques used in developing the data.

20785 (SAN—1470-T2) **Development of a risk-analysis model. Final report.** (Dynatrend, Inc., Arlington, VA (USA)). Oct 1979. Contract EC-77-C-03-1470. 140p. Dep. NTIS, PC A07/MF A01.

This report consists of a main body, which provides a presentation of risk analysis and its general and specific application to the needs of the Office of Buildings and Community Systems of the Department of Energy; and several case studies employing the risk-analysis model developed. The highlights include a discussion of how risk analysis is currently used in the private, regulated, and public sectors and how this methodology can be employed to meet the policy-analysis needs of the Office of Buildings and Community Systems of the Department of Energy (BCS/DOE). After a review of the primary methodologies available for risk analysis, it was determined that Monte Carlo simulation techniques provide the greatest degree of visibility into uncertainty in the decision-making process. Although the data-collection requirements can be demanding, the benefits, when compared to other methods, are substantial. The data-collection problem can be significantly reduced, without sacrificing proprietary-information rights, if prior arrangements are made with RD and D contractors to provide responses to reasonable requests for base-case data. A total of three case studies were performed on BCS technologies: a gas-fired heat pump; a 1000 ton/day anaerobic digestion plant; and a district heating and cooling system. The three case studies plus the risk-analysis methodology were issued as separate reports. It is concluded that, based on the overall research of risk analysis and the case-study experience, that the risk-analysis methodology has significant potential as a policy-evaluation tool within BCS.

20786 (SERI/TP—351-431, pp 343-348) **MRT method of computing radiant energy exchange in rooms.** Carroll, J.A. (UCSD Energy Center, La Jolla, CA). 1980.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

The MRT View Factor method presented couples each surface in a room to an MRT node, which acts as a clearinghouse for all radiative exchanges. An upward adjustment in the coupling between each surface and MRT exactly cancels that surface's self-weight in the MRT. The adjustments also happen to improve the accuracy of the conventional view factors implicitly assigned by MRT methods. The effects of surface emittance and air emittance (typically .05 to .15 in residences) are modelled without difficulty. For greatest accuracy, radiation coefficients can be varied with temperature. This method is inherently free from heat balance errors and errors in the overall radiative coupling of each surface to its environment. Errors do occur in the implicit view factors, but errors such as this are inherent in any method which overlooks the gory details of the enclosure geometry. Coplanar surfaces cause the largest errors, and these errors can be compensated for if necessary.

20787 **State of Nevada energy conservation standards for new building construction.** Carson City, NV; Nevada Department of Energy (1978). 109p. (NP—24394). State Public Works Board, Carson City, NV.

The standards established for the conservation of energy in buildings in which construction started on or after July 1, 1978, in the state of Nevada are presented. These standards were authorized by NRS 523.163. The purpose; definitions;modification; variances; enforcement and violations; application, scope, and exceptions; design conditions; building design by systems analysis and design of building utilizing nondepletable energy sources; building design by component performance approach; and building design by acceptable practice are covered in the standard.

20788 **Energy demand for space heating in the United States.** Chern, W.S.; Lin, W.W. pp 60-74 of Econometric studies in energy demand and supply. Maddala, G.S.; Chern, W.S.; Gill, G.S. (eds.). New York, NY; Praeger Publishers (1978).

This chapter breaks up the demand for space heating into two components: the short-run usage function, and the long-run fuel-choice function which characterizes the appliance-ownership decision. A model of space-heating demand is developed for the major fuels in the residential sector, namely: electricity, natural gas, and petroleum products. The study finds that the usage elasticities are much smaller than the appliance choice elasticities. On the methodological side, the chapter illustrates the use of the market shares approach used in the chapter, Aggregate Demand for Energy in the United States, by W.S. Chern, and the estimation of logit models used in fuel choice functions.

RESIDENTIAL BUILDINGS

REFER ALSO TO CITATION(S) 20360, 20375, 20388, 20401, 20728, 20743

20789 (AD-A—075094) **Techniques for control of air infiltration in buildings. Final report, 1 September 1978-15 April 1979.** Shepherd, P.B.; Gerharter, J.E. (Johns-Manville Sales Corp., Denver, CO (USA). Research and Development Center). 30 Apr 1979. Contract DAAK70-78-D-0002. 118p. NTIS, PC A06/MF A01.

Materials and systems for reducing or eliminating air infiltration through almost all identified leakage sources have been found. Most of these materials are inexpensive, effective, and relatively easy to install or apply. These materials are generally designed to seal or

close up small cracks or large openings in residential buildings. They encompass a very broad range of different methods such as caulking, adhesive/glass mat, weatherstripping, vent dampers, and many more. Those items having suitable effectiveness have been incorporated into a recommended procedure for treating existing and new construction. This procedure relies on the use of a special fan assembly and test procedures for locating air leaks in existing buildings and for measuring induced air infiltration in all buildings. The effectiveness of the different materials and systems is quite variable. Cost effectiveness has not been reliably measured; however, existing evidence strongly points to many air infiltration reduction materials as being highly cost effective with the exception of storm doors and, in some instances, storm windows.

20790 (LBL—10527) **Impact of reduced ventilation on indoor air quality in residential buildings.** Berk, J.V.; Hollowell, C.D.; Pepper, J.H.; Young, R.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1980. Contract W-7405-ENG-48. 21p. (EEB-Vent—80-5; CONF-800608—2). Dep. NTIS, PC A02/MF A01.

From Air Pollution Control Association annual meeting; Montreal, Canada (Jun 1980).

Rising energy prices have generated a national incentive to reduce ventilation rates in buildings and thereby lower heating and cooling costs. One of the ramifications of reducing ventilation is that indoor air contaminants build up and pose a health risk to occupants. A research program being conducted to determine the extent to which low ventilation rates are compatible with good indoor air quality is described. Overall indoor air quality is influenced by air-exchange rates, types of appliances and building materials used, and occupant activities. From the numerous indoor air pollutants studied, four (carbon monoxide and nitrogen dioxide from gas appliances; formaldehyde from particle-board, plywood, urea formaldehyde foam insulation, and gas appliances; and radon from soil, building materials, and ground water) are receiving considerable attention in the context of potential health risks associated with energy conservation. Field monitoring studies in energy-efficient residential buildings have demonstrated that, in some cases, these indoor-generated pollutants exceed outdoor air-quality standards in houses having air-exchange rates of less than 0.5 air changes per hour. The results of our research suggest that further studies, designed to include a broader range of infiltration rates ad occupancy conditions, are needed before establishing energy-efficient infiltration standards for residential buildings.

20791 (PB—80-101967) **Economic analysis of insulation in selected masonry and wood-frame walls. Final report.** Petersen, S.R. (National Bureau of Standards, Washington, DC (USA)). Sep 1979. 138p. NTIS, PC A07/MF A01.

This report provides a life-cycle cost-benefit analysis of several alternative methods for insulating 8 inch(200 mm) concrete masonry walls in new single-family residences. In addition, a cost-benefit analysis for insulation in wood-frame walls is provided, consistent with the assumptions used in the masonry wall analysis. A dynamic load simulation model, NBSLD, was used to calculate the heating and cooling requirements for a 1176 square foot (110 square milimeters) house with different levels of thermal resistance for both wall types in eight geographic locations. These data are used to calculate the reduction in annual heating and cooling requirements due to several different types of insulation in the cores and furring spaces of the masonry wall and the cavities of the wood-frame wall. Economic analysis is applied to determine estimates of life-cycle savings from insulation for different locations and furnace types in order to determine the most cost-effective insulation level. In general it is found that the maximum economically justifiable level of insulation in the masonry wall is considerably lower than for the wood-frame wall because of the significantly higher cost of insulating masonry walls.

20792 (STU—79-4003) **Seasonal heat storage in small houses.** Bakken, K. (Styrelsen foer Teknisk Utveckling, Stockholm (Sweden)). Nov 1979. 31p. (In Swedish). (STU—78-4473; STU—78-3094AB). Dep. NTIS (US Sales Only), PC A03/MF A01.

The report describes a heat storage system, Tepidus, with the capacity to supply the total heating and hot water volumes for a one-family house. The system comprises underground loops for heat storage and extraction, a heat accumulator containing 7 tons of sodium sulfide, a heat exchanger, and a chemical heat pump. The system produces about 20 MWh/year; the heat accumulator can store and produce 7 MWh. Solar collectors, diesel-fueled heat pumps, or waste heat sources are considered to be suitable primary energy sources for the system.

20793 **All through the house: a guide to home weatherization.** Blandy, T.; Lamoureux, D. New York, NY; McGraw-Hill, Incorporated (1980). 184p. (NP—24390).

Information covering insulation, weatherstripping, thermostats, and similar energy-conserving techniques are presented. Procedures for dealing with bankers and contractors are explained. How a wall works, how the human body reacts to heat and cold, and a thermal diagnosis are included in the first three chapters. Other chapters are Improving the Home; Choosing Materials; Getting It Done; Paying For It; Getting Advice; Achieving Comfort; The Making of Warm (the annual cycle and learning the process of wood heating); and The General Form of the House.

20794 **Comprehensive examination of the energy requirements, costs, and environmental and legal implications of expanded use of ground water source heat pumps.** Nadas, D. Albany, NY; New York State Energy Research and Development Authority (1978). 459p. (NP—24332).

The technical, economic, energy conservation, and environmental aspects of using ground water source heat pumps for heating and cooling residential units in New York State were examined. This study concluded that up to 70% of New York State has ground water resources suitable for the successful operation of such heat pumps; home heating with ground-water heat pumps would reduce energy consumption by 69% as compared with electric heating, up to 31% vs fossil-fuel heating and 31% as compared with air-to-air heat pumps; no legal obstacles nor adverse environmental effects are evident; the paback period for installing these heat pumps in houses ranges from 4 to 10 y as compared with fossil-fuel heating systems and 16 y as compared with the base price of air-to-air heat pump systems; and the development of demonstration projects is recommended. (LCL)

20795 **Aggregate demand for energy in the United States.** Chern, W.S. pp 5-43 of Econometric studies in energy demand and supply. Maddala, G.S.; Chern, W.S.; Gill, G.S. (eds.). New York, NY; Praeger Publishers (1978).

This report provides statistical evidence of the demand-price relationship for several important energy sources used in various consuming sectors. Tabulated data show end-use energy consumption by fuel type and by consuming sectors in the US in 1976. In the residential and commercial sector, natural gas, petroleum products, and electricity are major end-use energy sources. Coal is another important source of energy used in the industrial sector. The transportation sector used predominantly only petroleum products (97%). Two studies of energy demand are conducted at the national level. One deals with demand for major fuels in the residential and commercial sector. The other deals with industrial demand for electricity.

20796 **Residential demand for electricity in the TVA area.** Gill, G.S.; Maddala, G.S. pp 44-59 of Econometric studies in energy demand and supply. Maddala, G.S.; Chern, W.S.; Gill, G.S. (eds.). New York, NY; Praeger Publishers (1978).

Residential demand for electricity in the TVA Area analyzes that demand during the 1962-1972 period. The study is based on a time series of 11 years for 147 distributors. Apart from showing that there has been a definite structural break in the demand function in 1967, the chapter illustrates problems of analyzing structural change and in pooling cross-section and time-series data using the variance components models and least squared with dummy variables.

SCHOOL, MUNICIPAL AND OTHER PUBLIC BUILDINGS

20797 (AD-A—071673) **Bathythermographic surveys near naval facilities at Point Mugu, California, and Pearl Harbor, Hawaii. Final report.** Hansen, R.M. (Intersea Research Corp., San Diego, CA (USA)). May 1979. Contract N68305-78-C-0018. 61p. NTIS PC A04/MF A01.

The use of naturally cold sea or lake water in place of mechanically chilled water in air conditioning systems was found to be a feasible and energy saving concept for Naval Facilities like those at Point Mugu, CA, and Pearl Harbor, HI. The economic feasibility of this type of air conditioning at these sites depend on the distance and the water depth of the cold water source at the sites. In order to determine these distances and these depths, surveys were conducted which involved (1) assembly of existing data on seawater temperatures and (2) measurement of these temperatures with expendable bathythermographs (XBT). A summary of this existing data and the results of these measurements are given in this report. On the basis of this data and these measurements, estimates were made of the profiles of maximum annual seawater temperature which are also given. It was found that the maximum annual bottom water temperature at the Point Mugu site can be expected in November; it is 10 C (50 F) at a depth of 190 M (620 ft) 1.4 NM offshore. This temperature at the Pearl Harbor site can be above 10 C at a depth of 420 M (1,380 ft) 4.0 NM offshore.

20798 (CONF-800343—1) **Engineering audits at Minnesota State-owned facilities.** Hirst, E. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 4p. Dep. NTIS, PC A02/MF A01.

From Conference on state energy audit impact '80; Norcross, GA, USA (Mar 1980).

Results obtained from detailed engineering audits performed at 41 institutions operated by the State of Minnesota are analyzed.

These institutions include community colleges, state universities, office buildings, hospitals, and Department of Transportation regional facilities. The audits cover 270 buildings and include 2010 individual energy conservation recommendations. Implementing all these suggestions would cut energy use by 93 MBtu/ft²-audited, equivalent to at least 30% of baseline energy use at these institutions. The cost to implement these measures is almost $2/ft² with an average payback period of less than eight years (at 1978 fuel prices).

20799 (DOE/CS—0148) **Energy Conservation Programs for schools, hospitals and buildings owned by units of local government and public care institutions. Report to Congress for FY 1979. Annual report.** (Department of Energy, Washington, DC (USA)). 1979. 12p. Dep. NTIS, PC A02/MF A01.

The National Energy Conservation Policy Act of 1978 (NECPA) authorized the Department of Energy (DOE) to implement multi-sector energy conservation grant programs aimed at assisting public and private non-profit schools and hospitals, and units of local government and public care institutions. This Report, describes DOE efforts during FY 1979 to establish and implement the programs and procedures required under Title III NECPA. The Report contains discussions of the program's legislative background and authorization, a description of the Title III programs and the management system developed for the programs, and program accomplishments in FY 1979 and goals for FY 1980. As appendices to the report DOE has included the management plans for Phase I and Phase II and the regulation governing the programs. During FY 1979, DOE completed all preparatory work for such grant programs, including the development of proposed and final regulations for the operation of the program, and developed comprehensive management plans for the coordination and execution of program activities. By the end of FY 1979, DOE had succeeded in full implementation of Phase I, granting approximately $26 million to States and territories to support the conduct of preliminary energy audits and energy audits. DOE is currently reviewing and acting upon State Plans for the implementation of Phase II, technical assistance and energy conservation measures programs, and expects to award some $158 million in grants to institutions and local governments during the first three months of calendar year 1980. As of December 10, 1979 DOE has approved 23 State Plans, and intends to complete the approval of the remaining State Plans by January 1, 1980. These milestones, accomplished in less than one yar of NECPTA's enactment, marked the initiation of both program phases.

20800 (LBL—10553) **Effects of energy conservation measures on air hygiene in public buildings: final report.** Dimmick, R.L.; Wolochow, H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Feb 1980. Contract W-7405-ENG-48. 62p. (EEB-Vent—80-2). Dep. NTIS, PC A04/MF A01.

The results obtained during a year's continuation of a research project intended to measure the numbers of airborne bacteria in air of schools and hospitals before and after measures were taken to reduce the intake of outside air for ventilation purposes are documented. The report of April 1, 1979, LBID-045, entitled Studies of Effects of Energy Conservation Measures on Air Hygiene in Public Buildings, by R.L. Dimmick and H. Wolochow, includes a section describing the equipment, materials, techniques of sampling, and the research approach. That information is not repeated in this report except for the noting of any changes that have been made. A brief description of samplers and methodologies is presented.

20801 (PB—80-101496) **Analysis of engineering audits at state-owned buildings in Minnesota.** Hirst, E.; Tyler, R.; Eastes, C.; Dumagan, J. (Minnesota Energy Agency, St. Paul (USA)). Sep 1979. 57p. NTIS, PC A04/MF A01.

This report describes the contents and analyzes the results of detailed engineering audits performed at 41 institutions owned by the State of Minnesota. These institutions include community colleges, state universities, office buildings, hospitals, and Dept. of Transportation regional facilities. The audits covered 270 buildings and include 2010 individual energy conservation recommendations.

COMMERCIAL AND INDUSTRIAL BUILDINGS

REFER ALSO TO CITATION(S) 20795

20802 (CONF-791009—38) **Regional analysis of future commercial energy demand.** Corum, K.; Cohn, S. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 7p. Dep. NTIS, PC A02/MF A01.

From International conference on energy use management; Los Angeles, CA, USA (22 Oct 1979).

The modification of a national model of energy use in the commercial sector to project energy use for the 10 Federal regions is described. In particular, regional floorspace and energy-use data are developed and incorporated into the regional model. Finally, the revised model is used to project regional energy use to the year 2000, and some of the regional variation in the projection is analyzed.

TRANSPORTATION

REFER ALSO TO CITATION(S) 20743, 20784, 20795

20803 (COO—4136-1(Vol.1)) **Future transportation systems of the Great Lakes Region: energy and econoics. Volume 1. Executive Summary. Final report.** Bushnell, R.C. (Wayne State Univ., Detroit, MI (USA). School of Business Administration). Oct 1979. Contract EY-76-S-02-4136. 40p. Dep. NTIS, PC A03/MF A01.

A comprehensive network model which could predict the modal share competitive impact of various changes in cost and physical facilities was built. Reports were commissioned from experts in the fields of rail, waterborne, truck, pipeline transport, and an essay on Canadian transportation systems. The essays appear in Volume II. The details of the model appear in Volume III; procedure listings appear in Volume IV; and the final Volume V contains supplemental reports. Five varieties of data or analytical procedures contained in the model are: the interregional flows by commodity; the networks, links, and routes over which physical goods move; data defining the characteristics of the networks over which the goods move; analytical models which translate the characteristics into costs, rates, and other attributes which are transmitted to, or are perceived by, transportation decision makers; and analytical models simulating the joint routing decisions of owners-of-goods and transporters. Some details of the model are presented.

20804 (ORNL/Sub—79/45740/1) **Worldwide transportation/energy demand, 1975-2000. Revised Variflex model projections.** Ayres, R.U.; Ayres, L.W. (Variflex Corp., Washington, DC (USA)). Mar 1980. Contract W-7405-ENG-26. 176p. Dep. NTIS, PC A09/MF A01.

The salient features of the transportation-energy relationships that characterize the world of 1975 are reviewed, and worldwide (34 countries) long-range transportation demand by mode to the year 2000 is reviewed. A worldwide model is used to estimate future energy demand for transportation. Projections made by the forecasting model indicate that in the year 2000, every region will be more dependent on petroleum for the transportation sector than it was in 1975. This report is intended to highlight certain trends and to suggest areas for further investigation. Forecast methodology and model output are described in detail in the appendices. The report is one of a series addressing transportation energy consumption; it supplants and replaces an earlier version published in October 1978 (ORNL/Sub-78/13536/1).

AIR AND AEROSPACE

20805 (OTA-T—112) **Impact of advanced air transport technology. Part I. Advanced high-speed aircraft.** (Office of Technology Assessment (U.S. Congress), Washington, DC). Apr 1980. 115p. Dep. NTIS, PC A06/MF A01.

The economic, environmental, energy, societal and safety impacts of advances in high-speed aircraft technology were examined to determine the potential benefits of advanced supersonic transport (AST) aircraft and the justification for Federal funding to support development of this technology. This study found that: the long-term prospects for advanced supersonic transports are significant and real; the uncertainties, specifically, fuel price and availability, noise, and market size, are also significant and real; the potential threat from foreign competitors appears tempered by the same uncertainties; support of a generic R and D program appears appropriate in order to maintain the option for future development of an AST, and clarify and reduce the technical uncertainties, however, it would not shed light on those external factors governing the viability of an AST such as the increasing sensitivity of the public to aircraft noise, the price and availability of adequate fuel supplies, and the availability of adequate fuel supplies, and the availability of financing for such a major capital commitment; and if Congress wishes to maintain the US supersonic option, then the existing level of Federal support is not considered adequate to accomplish this. (LCL)

LAND AND ROADWAY

REFER ALSO TO CITATION(S) 20856, 20862

20806 (DOE/CS—0154) **Alternative fuels, fuel additives, and related devices for highway vehicles: R, D and D proposal guidelines.** (Department of Energy, Washington, DC (USA). Office of Transportation Programs). Apr 1980. 25p. Dep. NTIS, PC A02/MF A01.

DOE's Office of Transportation Programs (TP) is responsible for developing new technology which will help decrease US dependence on and eventually replace petroleum as the major fuel re-

source. Guidance and criteria for the preparation of proposals to the Alternative Fuels Utilization Branch (AFUB) of the TP are provided. Alternative fuels, fuel additives, and engine/vehicle hardware that relate specifically to alternative fuel(s) handling and management are the specific concerns of the AFUB. Accordingly, there are unique requirements for proposals to the AFUB. Test data requirements for alternative fuels, fuel additives, extenders, and alternative fuels and related devices and systems are presented. A summary of submission requirements is included.

20807 (PB—80-101272) **A study of aerodynamic methods for improving truck fuel economy.** Buckley, F.T. Jr.; Marks, C.H.; Walston Jr., W.H. (Maryland Univ., College Park (USA). Dept. of Mechanical Engineering). Dec 1978. 404p. NTIS, PC A18/MF A01.

Results of a 3-year program to investigate aerodynamic means to reduce fuel consumption of tractor-trailer trucks are reported. The study considers the benefit of aerodynamic add-on devices to reduce the aerodynamic drag on existing vehicles, and the influence of design alternatives in reducing the drag of future vehicles. Results are obtained for scaled-models in water table and wind-tunnel experiments, and for full-scale vehicles in coast-down and fuel economy tests. Wind statistics, analyzed to estimate national-average highway wind conditions, and basic aerodynamic data obtained in the experiments are used to define a wind-averaged aerodynamic drag, or drag reduction for national-average operating conditions. Drag reductions of both commercial and newly-developed retrofit drag reducing devices are evaluated. Full scale test results indicate that wind turbulence effects cause the full-scale drag reductions produced by retrofit devices to be generally less than those found in the wind tunnel. The decrease is found to be a function of the design of the device and the ambient conditions in which it is used, and is the least for a fairing/gap seal combination which produces wind-averaged aerodynamic drag reductions of up to 36% in wind-tunnel experiments.

20808 (PB—80-101975) **A brief treatise on the problems associated with using one vehicle to determine the dynamometer power absorption for a second similiar vehicle. Technical report.** Thompson, G.D. (Environmental Protection Agency, Ann Arbor, MI (USA)). Mar 1978. 12p. NTIS, PC A02/MF A01.

The current EPA regulations for exhaust emission certification and fuel economy measurements allow a manufacturer the option of road testing a vehicle to determine a dynamometer adjustment which will subsequently be used for all vehicles of a similar class. In the process of using the road test results from one vehicle to determine the dynamometer adjustment for a second vehicle there is the potential for error. This report briefly discusses the magnitude of these possible errors. Two specific cases are considered. In the first case the error is assumed that good engineering practices are used. In the second case it is assumed that the potential for error is used in a systematic manner to result in a reduced loading for the second vehicle.

20809 (PB—297583) **Effects of inspection and maintenance programs on fuel economy. Technical report.** (Environmental Protection Agency, Ann Arbor, MI (USA). Inspection and Maintenance Staff). Mar 1979. 15p. NTIS PC A02/MF A01.

The primary goal of inspection and maintenance (I/M) programs is to improve air quality by reducing emissions from motor vehicles. Many studies have indicated that I/M programs will achieve this goal. In addition several studies have indicated that fuel economy improvement can be expected to occur as a result of maintenance performed on vehicles failing an I/M test. Most studies which have been performed have looked at pre-1975 model year vehicles and have had expert mechanics performing the maintenance work. It is the intention of the present report to consider both the results from past studies and the results from more recent studies in order to provide EPA's best estimates of fuel economy benefit which can be attributed to I/M maintenance.

20810 (UMTA-MA—0060-79-1) **LIFT: special needs transportation in Portland, Oregon. Final report.** Cooper, T. (Crain and Associates, Menlo Park, CA (USA)). Aug 1979. 299p. NTIS.

The Portland Special Needs Transportation Demonstration, the LIFT, is a project in which Tri-Met (the regional transit authority), in coordination with local social service agencies, provides door-to-door transportation service to eligible handicapped and elderly clients on an advance-reservation basis. Eligibility for the LIFT service was based upon a functional (rather than clinical) definition of transportation handicap - a person was considered eligible for the service if they had difficulty performing certain functions that were necessary in riding a fixed-route bus, e.g., reading directions, standing for more than 10 minutes, moving in crowds, etc. A fleet of 15 lift-equipped buses is operated by Tri-Met, supplemented by transportation provided through a Tri-Met contract with local private providers, i.e., taxis. Fares are $3.00 per trip for agency-affiliated passengers, with the $3.00 paid by the sponsoring agency, and $.50 per trip for eligible general passengers, with the fare paid by the passenger. This report covers the two years of the demonstration, from December 1976 to December 1978. During this time, the LIFT project experienced gradual but steady growth in terms of client registration and trips delivered. As of December 1978 the Lift system was providing 370 trips per day; 18% of these trips were by LIFT-sponsored taxis and 17% of all trips were taken by persons using a wheelchair. This report documents a number of conclusions regarding the LIFT demonstration.

SEA AND WATER

20811 (NP—24321) **Contribution to the thermal calculation of ship propulsion steam generators for LNG tanker ships.** Didiot, J. (Hannover Univ. (Germany, F.R.). Fakultaet fuer Maschinenwesen). 9 Feb 1978. 106p. (In German). Dep. NTIS (US Sales Only), PC A06/MF A01.

Steam systems are particularly suitable for LNG tanker ship propulsion as the LNG boil-off can be completely combusted at sea as well as in a harbor. The fuel consumption of a ship propulsion steam system is directly dependent on the efficiencies of the steam circuit and boiler. The steam generator burns either pure fuel oil or a mixture of fuel oil and boil-off. The influences of the natural gas composition which differs according to the deposit and of the nitrogen content which varies during the ship's voyage, as well as the consequences of the boil-off/heating fuel oil ratio for power, efficiency, flue gas temperature, and superheated steam temperature characteristic of the steam generator are investigated.

INDUSTRY AND AGRICULTURE

REFER ALSO TO CITATION(S) 20721, 20723, 20784, 21155, 21156

20812 (DOE/CS/05310—01(Vol.1)) **Industrial cogeneration optimization program.** (Westinghouse Electric Corp., Pittsburgh, PA (USA); Gibbs and Hill, Inc., New York (USA)). Jan 1980. Contract EM-78-C-01-5310. 226p. Dep. NTIS, PC A11/MF A01.

The purpose of this program was to identify up to 10 good near-term opportunities for cogeneration in 5 major energy-consuming industries which produce food, textiles, paper, chemicals, and refined petroleum; select, characterize, and optimize cogeneration systems for these identified opportunities to achieve maximum energy savings for minimum investment using currently available components of cogenerating systems; and to identify technical, institutional, and regulatory obstacles hindering the use of industrial cogeneration systems. The analysis methods used and results obtained are described. Plants with fuel demands from 100,000 Btu/h to 3 x 10^8 Btu/h were considered. It was concluded that the major impediments to industrial cogeneration are financial, e.g., high capital investment and high charges by electric utilities during short-term cogeneration facility outages. In the plants considered an average energy savings from cogeneration of 15 to 18% compared to separate generation of process steam and electric power was calculated. On a national basis for the 5 industries considered, this extrapolates to saving 1.3 to 1.6 quads per yr or between 630,000 to 750,000 bbl/d of oil. Properly applied, federal activity can do much to realize a substantial fraction of this potential by lowering the barriers to cogeneration and by stimulating wider implementation of this technology. (LCL)

20813 (DOE/CS/05310—01(Vol.2)) **Industrial cogeneration optimization program. Volume II. Appendix A. Conceptual designs and preliminary equipment specifications. Appendix B. Characterization of cogeneration systems (near-term technology). Appendix C. Optimized cogeneration systems.** (Westinghouse Electric Corp., Pittsburgh, PA (USA); Gibbs and Hill, Inc., New York (USA)). Jan 1980. Contract EM-78-C-01-5310. 313p. Dep. NTIS, PC A14/MF A01.

This appendix to a report which evaluates the technical, economic, and institutional aspects of industrial cogeneration for conserving energy in the food, chemical, textile, paper, and petroleum industries contains data, descriptions, and diagrams on conceptual designs and preliminary equipment specifications for cogeneration facilities; characterization of cogeneration systems in terms of fuel utilization, performance, air pollution control, thermal energy storage systems, and capital equipment costs; and optimized cogeneration systems for specific industrial plants. (LCL)

ENERGY SOURCES

REFER ALSO TO CITATION(S) 20317, 20795

20814 (AD-A—071791) **Considerations in selecting wood as an immediate source of reliable and economical energy for military installations. Final report.** Helms, S.A. (Army Facilities Engineering Support Agency, Fort Belvoir, VA (USA). Technology Support Div.). 1 Dec 1978. 83p. NTIS PC A05/MF A01.

This report is an introduction to the state-of-the-art in wood harvesting, handling, procurement and combustion. Any decision to

use wood as an energy source can only be made after careful consideration of the total system, i.e., stump to stack. This document contains or referenced sufficient back-up information that the reader can identify reliable sources of expertise.

20815 (AD-A—072755) **Coal as an alternate fuel for Naval vessels. Master's thesis.** Rowland, C.B. (Naval Postgraduate School, Monterey, CA (USA)). May 1978. 157p. NTIS, PC A08/MF A01.

This thesis examines the possible uses of coal and coal-derived fuels for propulsion of the ships of the United States Navy. The need for this study was precipitated by the worsening supply of oil in the world. Included is a review of the world energy problem, and estimates of when real shortages in petroleum can be expected. Atmospheric fluidized bed combustors and pulverized coal furnaces are examined as modern methods of solid coal firing. Their impact on ship size as compared to more conventional means of powering, was examined through use of a computer aided ship synthesis model. The use of coal for existing ships was limited to a discussion of coal-derived liquid fuels and coal/oil slurries.

20816 (DOE/EIA—10547-01) **Technical and economic feasibility of alternative fuel use in process heaters and small boilers.** (Energy and Environmental Analysis, Inc., Arlington, VA (USA)). Feb 1980. Contract AC01-79EI10547. 302p. Dep. NTIS, PC A14/MF A01.

The technical and economic feasibility of using alternate fuels - fuels other than oil and natural gas - in combustors not regulated by the Powerplant and Industrial Fuel Use Act of 1978 (FUA) was evaluated. FUA requires coal or alternate fuel use in most large new boilers and in some existing boilers. Section 747 of FUA authorizes a study of the potential for reduced oil and gas use in combustors not subject to the act: small industrial boilers with capacities less than 100 MMBtu/hr, and process heat applications. Alternative fuel use in combustors not regulated by FUA was examined and the impact of several measures to encourage the substitution of alternative fuels in these combustors was analyzed. The primary processes in which significant fuel savings can be achieved are identified. Since feedstock uses of oil and natural gas are considered raw materials, not fuels, feedstock applications are not examined in this analysis. The combustors evaluated in this study comprise approximately 45% of the fuel demand projected in 1990. These uses would account for more than 3.5 million barrels per day equivalent fuel demand in 1990.

20817 (NP—24407) **Fan cycling and energy consumption in bulk tobacco curing.** Cundiff, J.S. (Georgia Univ., Athens (USA). Dept. of Agricultural Engineering). Jul 1978. 29p. TIC.

An on-farm test was conducted with four mobile style bulk rack barns. Barns 1 and 2 had insulation added to the side walls and ceiling. Barn 4 was a factory insulated, unmodified conventional barn. Each barn was operated with continuous fan operation except Barn 1 which was cycled ON 20 min OFF 25 min from 1200 to 1700 hrs each day of the cure. Averaged over six cures, the petroleum fuel consumption, expressed as MJ/kg cured leaf (oven dried), was 19.2 Barn 1, 18.6 Barn 2, 20.2 Barn 3, and 16.0 Barn 4. The lower stalk cures (Cures 2-3) required more energy than the upper stalk cures (Cures 6-7); 104% more in Barn 1, 85% more in Barn 2, 60% more in Barn 3, and 58% more in Barn 4. Fan cycling had a negligible effect on petroleum fuel consumption. Chemical analysis of the cured leaf revealed a total nitrogen/total alkaloids ratio for all cures that is typical for type 14 tobacco.

EQUIPMENT AND PROCESSES

REFER ALSO TO CITATION(S) 20732, 20733, 20817

20818 (AD-A—072920) **Quantitative analysis of energy usage in central food preparation system at Fort Lee, Virginia. Technical report.** Hu, K.H.; Swift, J.; Hudson, G.W.; Lampi, R.A.; Tuomy, J.M. (Army Natick Research and Development Command, MA (USA). Food Engineering Lab.). Apr 1979. 85p. NTIS, PC A05/MF A01.

This report presents the results of an energy evaluation of the Central Food Preparation System (CFPS) and three dining halls at Fort Lee, Virginia. As far as cooking was concerned, there were energy savings in cooking large batches of food with large equipment at CFPS vs. cooking small batches of food with small equipment at the individual dining halls. However, due to the extra steps required for freezing, storing, and reheating of the CFPF prepared entrees, there was an additional energy expenditure as compared to foods freshly prepared and served in dining halls. Concerning the preparation of salads, gelatin desserts, and slicing of cold-cut meats in the Ingredient Preparation Facility (IPF), there was a net energy savings in using IPF-prepared foods because of no cook-freeze system involved. This report also presents data on comparisons of electricity vs. gas cooking and large batches vs. small batches. Considering different energy costs, electricity is ranked as the major energy cost, and the cost of heating water is second.

20819 (BSDF—38-2Q-80) **Evaporation by mechanical vapor recompression. Technical progress report, January 1, 1980-April 1, 1980.** Iverson, C.H.; Coury, G.E. (Beet Sugar Development Foundation, Fort Collins, CO (USA)). 1980. Contract AC03-79C40208. 80p. Dep. NTIS, PC A05/MF A01.

Progress for the period from January 1, 1980 to April 1, 1980, in the development of a study of the application of the technologies of Mechanical Vapor Recompression and Falling Film Evaporation as applied to the beet sugar industry is reported. Progress is reported in the following areas: technical literature search; report on visit to European factories using these technologies; energy balance studies of facories offered by the industry as candidates for the demonstration plants; and report on energy balance studies and the recommendations as to the site for the demonstration plant.

20820 (LUTMDN/TMVK—5087/1-78/(1979)) **Study of the energy efficiency of the melting unit at the Rockwool company mineral wool process in Skoevde, Sweden.** Fredriksson, R.; Persson, L. (Tekniska Hoegskolan, Lund (Sweden). Inst. foer Vaerme- och Krafttekniik). 1979. 78p. (In Swedish). Dep. NTIS (US Sales Only), PC A04/MF A01.

The melting unit, consisting of a water-cooled cupola furnace, afterburner, heat exchanger, air preheater, consumes most of the supplied energy in the rockwool process. The report maps the energy flows and defines factors of merit according to thermodynamics. Primary reasons for the low efficiency are found in the water cooling and the high CO-content in the exhaust gases from the furnace. The afterburner and heat exchanger also have very low efficiency.

20821 (NP—24274) **Energy audit series. No. 5. Glass industry.** Perry, G.; Doyle, P.J. (Department of Energy, London (UK); Department of Industry, London (UK)). Jun 1979. 65p. Dep. NTIS (US Sales Only), PC A04/MF A01.

This analysis of the use of energy for producing glass and glass products in the UK was performed to identify energy-intensive areas in the glass manufacturing process, to establish energy conservation opportunities, and to recommend research programs on glass industry energy conservation. Information is included on the industrial processes and equipment, energy demand and fuel consumption, products manufactured, and change which would result improved energy efficiency. (LCL)

20822 (NP—24305) **Energy audit series. No. 6. Aluminium industry.** (Department of Energy, London (UK); Department of Industry, London (UK)). Jun 1979. 75p. Dep. NTIS (US Sales Only), PC A04/MF A01.

The object of this audit was to study the use of energy in the aluminum industry, in the UK. Energy demands for producing primary aluminum from minerals, scrap aluminum processing, and aluminum parts fabrication were determined. The energy analysis method used, data on energy consumption, and opportunities for energy conservation in the aluminum industry are presented. (LCL)

20823 (PB—80-106115) **Environmental considerations of selected energy-conserving manufacturing process options. Volume XIX. Solid residues summary report. Final report.** (Little (Arthur D.), Inc., Cambridge, MA (USA)). Aug 1979. Contract EPA-68-03-2198. 107p. NTIS, PC A06/MF A01.

Arthur D. Little, Inc. undertook a study of the 'Environmental Considerations of Selected Energy-Conserving Manufacturing Process Options'. Some 80 industrial process options were examined in 13 industrial sectors. Results were published in 15 volumes, including a summary, industry prioritization report, and 13 industry oriented reports. This present report summarizes the information regarding sulfur oxide pollutants in the 13 industry reports. Four parallel reports treat nitrogen oxides, particulates, solid residues, and toxics/organics. All of these pollutant-oriented reports are intended to be closely used with the original 15 reports.

WASTE HEAT RECOVERY AND UTILIZATION

REFER ALSO TO CITATION(S) 20385, 20428

20824 (CONS—2882-T1) **Data gathering in support of phase O program for waste heat utilization from nuclear enrichment facilities, Ohio.** (Ohio Dept. of Energy, Columbus (USA)). 25 Jun 1978. Contract ET-78-C-01-2882. 12p. Dep. NTIS, PC A02/MF A01.

The gathering of demographic, community development, and economic data for the region impacted by the Pikeville (Ohio) Nuclear Enrichment Facility is described. These data are to be used for establishing possible community uses, e.g., space heating, domestic water heating, and industrial uses, of waste heat from the facility. It was concluded that although the economic feasibility of such waste heat utilization remains to be proven, the community would cooperate in a feasibility demonstration program. (LCL)

INDUSTRIAL WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 20244, 20584

20825 (FE—3105-1) **Feasibility of alternatives for surface utilization of coal wastes. Final technical report, 29 July 1979.** Gushue, J.; Fischer, S.; Walker, J. (Energy Resources Co., Inc., Cambridge, MA (USA)). Jul 1979. Contract ET-78-C-01-3105. 287p. Dep. NTIS, PC A13/MF A01.

This report examines above-ground utilization of coal wastes generated in the mining and preparation of underground coal. Background information covers environmental impacts of surface disposal methods available techniques for coal waste utilization, properties of coal refuse and quantities to be generated in eastern and midwestern coal fields through 1985. The main objective of the study was to assess the economic and environmental feasibility of a selected utilization technique in a representative mining district. The feasibility of using coarse coal refuse in combination with power plant fly ash to form subbase course material for roadway construction is evaluated for the Monogalia County region in northern West Virginia. On the basis of technical, environmental and economic factors, it concluded that using coal refuse/fly ash material for roadway subbase construction is feasible in the study area. The key technical and environmental considerations are related to the compaction characteristics of the material. Chemical and physical testing of the material to establish properties, in-place performance, and optimum refuse/fly ash blends followed by proper mixing, handling and compaction during construction will result in a strong, environmentally benign subbase course. The costs of subbase construction with refuse/fly ash and with conventional materials were compared using cost factors in the 1978 Dodge Guide. Maximum usage of coal refuse/fly ash (3/1 ratio) on the 127 miles of new roadway planned through 1985 would utilize about 2.3 million tons of an estimated 7.5 millon tons of refuse to be generated in the study area. An annotated bibliography is included.

20826 (LBL—9176) **Energy reduction in phenol recovery systems.** Burns, G.P. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1979. Contract W-7405-ENG-48. 172p. Dep. NTIS, PC A04/MF A01.

Thesis.

A number of processes use liquid-liquid extraction to recover phenol from waste water streams. A set of criteria for the selection of a solvent suitable for phenol recovery was developed as part of a study to improve the energy consumption and/or reduce the complexity of such a phenol recovery process. Methyl isobutyl ketone (MIBK) was identified as being nearly ideal. Mutual solubilities and distribution coefficients were obtained for the system Phenol-Water-MIBK at 30°, 50°, and 70°C. In addition, a relatively simple process was developed for phenol recovery that offers significant energy savings. A mathematical model of the steam stripper for recovering MIBK from water was used in the development of the process.

20827 (PB—80-102288) **No/sub x/ emission factors for wood-fired boilers. Final report April-June 1979.** Nunn, A.B. (TRW Environmental Engineering Div., Durham, NC (USA)). Sep 1979. Contract EPA-68-02-2613. 37p. NTIS, PC A03/MF A01.

The report gives results of a review of NOx emission data from 14 wood-fired boilers. Types of wood used as fuel included sawdust, chips, shavings, edgings, bark, and other processing residues. Boilers tested ranged in size from 1.5 to 67 MW (4,500 to 200,000 lb steam/hr). The major finding was that wood-fired boilers emit considerably less NOx (on an energy basis) than fossil fueled boilers of comparable size, in spite of the fact that most wood-fired boilers operate with high levels of excess air, a practice normally associated with increased NOx emissions. Average emission factors were 0.3 g NOx per kg fuel for boilers less than 10 MW, and 1.6 g NOx per kg fuel for boilers greater than 10 MW.

20828 (PB—80-102890) **Research needs assessment - livestock manure management in the United States. Final report, 22 May 1978-30 April 1979.** White, R.K. (Ohio Agricultural Research and Development Center, Wooster (USA)). Aug 1979. 62p. NTIS, PC A04/MF A01.

The purpose of this report is to identify and assess research needs for livestock manure management as related to environmental quality. Needs identified are prioritized and assigned to one or more function areas, such as, environmental quality, demonstration, livestock production, education, and energy.

20829 (PB—80-106081) **Assessment of solid waste management problems and practices in the inorganic chemicals industry.** (Versar, Inc., Springfield, VA (USA)). Oct 1979. Contract EPA-68-03-2604. 164p. NTIS, PC A08/MF A01.

This report examines the solid wastes generated by the inorganic chemicals industry relative to the impact of Section 4004 of the Resource Conservation and Recovery Act. The report provides (1) a data base on the type and quantity and disposal techniques now applied for the control of inorganic chemicals; (2) the background information needed to develop a long-term strategy for Federal policies concerning solid wastes from the inorganic chemicals industry; (3) information concerning the costs to industry of meeting RCRA requirements, specifically Section 4004.

20830 (PB—80-801822) **Fly ash. Volume 2. 1976-1977 (citations from the NTIS data base). Report for 1976-1977.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Dec 1979. 157p. NTIS PC N01/MF N01.

This bibliography cites Federally funded research reports on fly ash generation, collection, disposal, and utilization. Dust collection devices, filters, precipitators, and scrubbers are included. The use of fly ash in soil stabilization, roads, cements, construction materials, and as absorbents are also covered. Additives for fly ash conditioning and combustion modification are studied, as well as fly ash analysis and fly ash related pollution sampling. (This updated bibliography contains 149 abstracts, none of which are new entries to the previous edition.)

20831 (PB—80-801830) **Fly ash. Volume 3. 1978-November 1979 (citations from the NTIS data base). Report for 1978-November 1979.** Smith, M.F. (National Technical Information Service, Springfield, VA (USA)). Dec 1979. 207p. NTIS PC N01/MF N01.

Government-sponsored research on fly ash generation, collection, disposal, and use is cited in the compilation. Studies on dust collection devices, filters, precipitators, and scrubbers are included. Additives for fly ash conditioning and combustion modification are studied, as well as fly ash analysis and fly ash related pollution sampling. The use of fly ash in soil stabilization, roads, cements, construction materials, and as absorbents are also covered. (This updated bibliography contains 201 abstracts, 132 of which are new entries to the previous edition.)

20832 (PB—80-801848) **Fly ash. Volume 3. November 1977-November 1979 (citations from the Engineering Index data base). Report for November 1977-November 1979.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Dec 1979. 263p. NTIS PC N01/MF N01.

Worldwide research is cited on fly ash as pertaining to pollution aspects. These studies cover fly ash scrubbing and collection, chemical analysis, utilization, and air pollution control equipment performance. The majority of these abstracts deal with electric power plants, fly ash use in cement and roadbeds, and waste disposal. Discussions of metal extraction and recovery from fly ash are included. (This updated bibliography contains 201 abstracts, 132 of which are new entries to the previous edition.)

20833 (PB—80-802267) **Textile processing wastes and their control (citations from the NTIS data base). Report for 1964-November 1979.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Dec 1979. 179p. NTIS PC N01/MF N01.

The bibliography contains selected abstracts of research reports covering textile processing, air pollution control, water pollution control, and solid waste disposal. Included are waste water treatment studies on dyes, biological industrial waste treatment, use of membranes, cost estimates of the control technology, and design criteria of control equipment. (This updated bibliography contains 173 abstracts, 32 of which are new entries to the previous edition.)

20834 (PB—80-802275) **Textile processing wastes and their control (citations from the Engineering Index data base). Report for 1970-November 1979.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Dec 1979. 124p. NTIS PC N01/MF N01.

These citations of worldwide research cover the textile industry as it deals with water pollution, air pollution, and solid wastes and their control. The bibliography includes studies of wastewater treatment of dyes, the use of activated carbon in the processes, design criteria of the control equipment, and reusing materials that are recovered in the control process. (This updated bibliography contains 218 abstracts, 26 of which are new entries to the previous edition.)

20835 (SERI/TP—31-248(Vol.2)(Pt.2), pp 519-535) **Corrosion problems associated with the incineration of refuse.** Krause, H.H.; Boyd, W.K. (Battelle Columbus Labs., OH). Oct 1979.

From Reliability of materials for solar energy workshop; Denver, CO, USA (18 Dec 1978).

There has been increasing incentive in recent years for disposal of municipal refuse by incineration. However, the corrosion of heat recovery surfaces exposed to combustion products from the burning of industrial and municipal wastes has been a major problem in utilizing these materials as a source of heat energy. Research conducted by Battelle in recent years has demonstrated that chlorine in the refuse is the most important contributor to corrosion of boiler tubes. The sulfur in the refuse plays a part in promoting corrosion by chlorine, and other components which are not present in fossil fuels such as zinc and lead may contribute to the unusual amount of corrosion which can occur during incineration. Experiments were

conducted to investigate the inhibition of chloride corrosion by the introduction of relatively large amounts of sulfur into the fuel. The results of this experimental program have shown that the sulfur and chlorine contents of refuse have significant effects on the corrosion of metal surfaces exposed to hot combustion products. From the data collected it can be concluded that: (1) the conversion of chlorides to sulfates in the incinerator deposits by the action of SO_2 releases chlorine and HCl at the metal surface, thereby causing serious corrosion: (2) chloride corrosion can be made negligible by increasing the total available sulfur in fuel to equal 2 wt % of the refuse; and (3) co-firing of refuse with high sulfur coal up to a 60/40 mix on a Btu basis will not increase the initial corrosion rate beyond that of coal alone.

20836 Disposal of sulfur oxide pollutant-containing gas. Moss, G. US Patent 4,081,513. 28 Mar 1978. Filed date 9 Dec 1975. 7p.

A pollutant such as SO_2 is removed from a pollutant-containing gas stream by passing the stream to a drying zone to which a solution and/or dispersion of pollutant-reactive material (such as CaO) is supplied, the drying zone operating to evaporate the liquid (e.g., water) and at least some pollutant reacting with the material to form an innocuous disposable solid which is removed, the pollutant-depleted gas stream being scrubbed in a scrubbing zone by a solution and/or dispersion of pollutant-reactive material to form substantially pollutant-free gas which is vented to atmosphere, the solution and/or dispersion being recovered from the scrubbing zone, some being recirculated back to the scrubbing zone after the addition of required make-up liquid and/or pollutant-reactive material, and some being passed to the drying zone preferably after concentrating the pollutant-reactive material therein. Preferably, the drying zone is a bed of solids fluidized by the incoming hot pollutant-containing gas stream.

20837 Three years of evauating a midwest anaerobic dairy lagoon. Fischer, J.R.; Porter, J.H.; Fulhage, C.D.; Meador, N.F. St. Joseph, MI; Americal Society of Agricultural Engineers (1978). 29p. (CONF-781238—2).

From Winter meeting for American Society of Agricultural Engineers; Chicago, IL, USA (18 Dec 1978).

Portions of document are illegible.

The University of Missouri Foremost Dairy Farm lagoon was monitored for 3 years. The lagoon receives animal waste from the milking parlor, holding pen, and feeding-loafing areas. The calculated volatile solids reduction was 80%. A relationship between temperature of the lagoon and lagoon degree days was calculated. A relationship between lagoon loading rate to lagoon degree days and mesophyllic digester loading rates was developed. Ammonia nitrogen accounted for 50 to 80% of the total nitrogen in the lagoon. Conductivity values of 2800 mhoc per con were observed in the latter sampling periods in the lagoon. Samples were obtained from 8 depths and 2 locations. (DC)

MUNICIPALITIES AND COMMUNITY SYSTEMS

REFER ALSO TO CITATION(S) 20785

20838 Heat pump systems for district heating and cooling. Calm, J.M. (Argonne Natl Lab, Ill). *ASHRAE J.*; **21**: No. 9, 54-58(Sep 1979).

By discussing the conservation potential of heat pump systems the author shows that more than one-quarter of the energy consumed in the U.S. is used to heat and cool buildings and to heat service water. Approximately 83% of the energy for these services is supplied from natural gas and oil. District heating and cooling systems using heat pumps to recover otherwise wasted and low-grade natural heat show potential to reduce net energy consumption for these services by 20 to 50%. Such heat-pump-centered systems also allow fuel substitution with nonscarce resources not practical in smaller, individual-building systems.

PUBLIC UTILITIES

20839 (ANL/CNSV—7) **Heat-pump-centered integrated community energy systems: system development summary.** Calm, J.M. (Argonne National Lab., IL (USA)). Feb 1980. Contract W-31-109-ENG-38. 127p. Dep. NTIS, PC A07/MF A01.

An introduction to district heating systems employing heat pumps to enable use of low-temperature energy sources is presented. These systems operate as thermal utilities to provide space heating and may also supply space cooling, service-water heating, and other thermal services. Otherwise-wasted heat from industrial and commercial processes, natural sources including solar and geothermal heat, and heat stored on an annual cycle from summer cooling may be effectively utilized by the systems described. These sources are abundant, and their use would conserve scarce resources and reduce adverse environmental impacts. More than one-quarter of the energy consumed in the United States is used to heat and cool buildings and to heat service water. Natural gas and oil provide approximately 83% of this energy. The systems described show potential to reduce net energy consumption for these services by 20 to 50% and to allow fuel substitution with less-scarce resources not practical in smaller, individual-building systems. Seven studies performed for the system development phase of the Department of Energy's Heat-Pump-Centered Integrated Community Energy Systems Project and to related studies are summarized. A concluding chapter tabulates data from these separately published studies.

20840 (ANL/CNSV-TM—31) **Saint Paul Energy Park: the potential for district heating.** Lee, C.; Kron, R.; Davis, H. (Argonne National Lab., IL (USA)). Mar 1980. Contract W-31-109-ENG-38. 58p. Dep. NTIS, PC A04/MF A01.

The results of ANL's study of the energy and economic aspects of using district heating in the St. Paul Energy Park are summarized. The Energy Park is a 6 million ft^2 residential, commercial office, and light industrial complex to be built in the midway area of St. Paul, Minnesota. Space heating and cooling design loads for the park were calculated assuming that the ASHRAE's 90-75 energy-conserving construction standards would be used in constructing the park's buildings. Based in part on this assumption, ANL estimated the costs and energy use characteristics of six possible energy system options for supplying Energy Park's space heating, space cooling, and domestic hot water heating needs. The results indicate that in today's economy, a central heating and cooling plant with natural gas boilers and electrically driven centrifugal chillers with thermal storage has good potential for energy and economic savings and clearly merits further consideration.

20841 (DOE/CS/20289—4) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regulatory programs in Arizona. Preliminary background report.** Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1980. Contract AC02-78CS20289. 56p. Dep. NTIS, PC A04/MF A01.

This report is one of a series of preliminary reports describing the laws and regulatory programs of the United States and each of the 50 states affecting the siting and operation of energy generating facilities likely to be used in Integrated Community Energy Systems (ICES). Public utility regulatory statutes, energy facility siting programs, and municipal franchising authority are examined to identify how they may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES. This report describes laws and regulatory programs in Arizona. The Arizona state constitution establishes the Arizona Corporation Commission to regulate public service corporations. Within the area of its jurisdiction, the Commission has exclusive power and may not be interfered with by the legislature except in one narrow instance as described in the case Corporation Commission v. Pacific Greyhound Lines.

20842 (INKA-Conf—79-095-005) **Peak load problems in district heating.** Winkens, H.P. (Stadtwerke Mannheim A.G. (Germany, F.R.)). 1979. 19p. (In German). (CONF-7905117—8). Dep. NTIS (US Sales Only), PC A02/MF A01.

From Conference on power demand and supply - analysis and strategies; Schliersee, F.R. Germany (16 May 1979).

After an explanation of the parameters of heat demand, some measures of meeting the peak load in a profitable way are discussed. One of the possibilities is the use of large short-time-heat storage. The reduction of the back-run temperature 30 to 40°C and the pre-run temperatures to 110°C expected in this development will improve the profitability of the use of storage for meeting demand peaks.

MUNICIPAL WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 20835

20843 (PB—80-101488) **Noise emission standards for surface transportation equipment - regulatory analysis of the noise emission regulations for truck-mounted solid waste compactors. Final report.** (Environmental Protection Agency, Arlington, VA (USA). Office of Noise Abatement and Control). Aug 1979. 501p. NTIS, PC A22/MF A01.

This document presents the technical data and analysis used by EPA in developing the Noise Emission Regulations for Truck-Mounted Solid Waste Compactors. The information presented includes a detailed description of the truck-mounted solid waste compactor industry and the product; baseline noise levels for current compactors; a description of the measurement methodology; an analysis of the health and welfare impacts and potential benefits of regulation; the noise control technology available; an analysis of the costs and potential economic effects of regulation; the enforcement procedures; existing local, state, and foreign regulations applicable to

compactor noise emissions; an analysis of comments to the public docket; and a description of the participation of the public throughout the development of the regulation.

EDUCATION AND PUBLIC RELATIONS

20844 (COO—4904-1) **Workshop on perspectives in energy: 1978. Final report.** (Kansas State Univ., Manhattan (USA). Center for Energy Studies). 1978. Contract EU-78-C-02-4904. 5p. Dep. NTIS, PC A02/MF A01.

A report on the Workshop on Perspectives in Energy is presented. The workshop, conducted from July 31 to August 10, 1978, included field trips, new energy topics of particular interest to the area around Kansas, and outside speakers. The response of the participants to the workshop are summarized.

20845 (DOE/CS—0151) **Comprehensive program and plan for Federal energy education, extension and information activities. Third report to Congress, P.L. 95-39, Title V: National Energy Extension Service Act.** (Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy). Mar 1980. 265p. Dep. NTIS, PC A12/MF A01.

The Federal energy extension and information activities program focuses on the need to save energy and switch to renewable fuel sources such as solar, wind, wood, or geothermal power. Outreach activities deliver information and technical assistance to communicate the importance of changes in energy consumption patterns, the energy-efficiency and renewable fuel options available, and the associated short- and long-term cost savings. The focal point of this third CPP is the statement of 12 principles as policy to guide Federal agencies in the coordination and management of their activities involving energy education, extension, and/or information.

20846 (DOE/HCP/M8656—02) **Resource file: practical publications for energy management, edition III.** (JRB Associates, Inc., McLean, VA (USA)). Mar 1980. Contract EM-76-C-01-8656. 218p. Dep. NTIS, PC A10/MF A01.

The Resource File is an in-depth bibliography of 166 practical and action-oriented energy conservation publications and materials. It is a reference tool, designed for Federal, state, and local energy managers or people who are asked to recommend how-to conservation guides to the public. Each listing describes a publication's intended audience and provides a summary of its contents. Included are operations and maintenance manuals, life-cycle costing handbooks, home insulation manuals, films on fuel-saving driving techniques, and courses devoted exclusively to home weatherization. 166 items.

ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

INTERNAL COMBUSTION ENGINES

20847 (AD-A—075355) **Exhaust emissions characteristcs for a general aviation light-aircraft Avco Lycoming TIO-540-J2BD piston engine. Final report.** Becker, E.E. (National Aviation Facilities Experimental Center, Atlantic City, NJ (USA)). Sep 1979. 104p. NTIS, PC A06/MF A01.

The Avco Lycoming TIO-540-J2BD engine (S/N890-X) was tested at the National Aviation Facilities Experimental Center (NAFEC) to develop a steady state exhaust emissions data base. This data base consists of current production baseline emissions characteristics, lean-out emissions data, effects of leaning-out the fuel schedule on cylinder head temperatures, and data showing ambient effects on exhaust emissions and cylinder head temperatures. The engine operating with its current full-rich production fuel schedule could not meet the proposed Environmental Protection Agency (EPA) standard for carbon monoxide (CO) and unburned hydrocarbons (HC) under sea level standard-day conditions. The engine did, however, meet the proposed EPA standards for oxides of nitrogen under the same sea level conditions. The results show a trend toward higher levels of emissions output for CO and HC when ambient conditions approximated hot day sea level conditions while producing slightly lower levels of NO(x).

20848 (LBL—10365) **Performance of a plasma jet igniter.** Cetegen, B.; Teichman, K.Y.; Weinberg, F.J.; Oppenheim, A.K. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jan 1980. Contract W-7405-ENG-48. 42p. (CONF-800202—3). Dep. NTIS, PC A03/MF A01.

From SAE automotive engineering congress and exposition; Detroit, MI, USA (25 Feb 1980).

The main advantage of jet igniters lies in their ability to provide distributed ignition sources that are capable of initiating and enhancing combustion in lean mixtures. This is achieved principally by two mechanisms, i.e., the provision of a high concentration of free radicals, enhancing ignition at lower temperatures, and of the extended highly turbulent igniting surface, yielding larger flame front areas and hence increased burning rates. Experimental and analytical procedures that were developed to determine the performance of a jet igniter with particular emphasis on the fluid mechanic effects are described. To de-emphasize the thermochemical effects, the plasma medium and energy were maintained without change for all the tests. Thus the only variables pertained just to the volume of the cylindrical plasma cavity and the area of the orifice discharging the jet. The results are based on high speed schlieren cinematography of the combustion process in a cylindrical bomb, and simultaneous pressure transducer measurements. The penetration depth is shown to be proportional to the square root of the characteristic length - the ratio of the volume of igniter cavity to its orifice area. The capability to ignite lean mixtures is demonstrated by the repeatibility of results attained with the use of methane-air mixtures at an equivalence ratio of 0.6, initially at atmospheric pressure and room temperature. Under these conditions the observed enhancement of the rate of combustion could be accounted for entirely by the fact that the flame surface was enlarged due to ignition by a highly turbulent jet. While the laminar burning velocity was well within the range reported in the literature, the corresponding turbulent burning velocity was about three times greater, the ratio between the two remaining nearly constant throughout the process.

SPARK-IGNITION

REFER ALSO TO CITATION(S) 20861

DIESEL

20849 (CONF-790749—, pp 832-865) **Advanced materials for improving diesel engine performance and emissions.** Kamo, R.; Cheng, C.; Williamson, A.S. (Cummins Engine Co., Columbus, IN). Dec 1979.

From Conference on advanced materials for alternate fuel capable directly fired heat engines; Castine, ME, USA (30 Jul 1979).

The objective of this program is to greatly improve the thermal efficiency of the diesel engine and to completely eliminate the water cooling system. The adiabatic turbocompound engine concept is described and its potential for improving diesel engine performance and emissions is discussed. An analysis of the cycle with and without ceramic insulation is shown. The operating conditions and factors which dictate the need for high performance ceramic materials are presented. The piston, cylinder head, valves, ports, manifold and cylinder liners will require at least 80% reduction of heat rejection from the combustion chamber and ports to make the concept viable. A composite piston using a ceramic piston cap with abrasive-blasted insulating shims for insulation is used. A composite cylinder liner using a high strength ceramic inner liner is also used. A plasma-sprayed zirconia coating applied over a fibermetal compliant layer insulates the cast iron cylinder head base. Other engine component design details for providing high temperature strength capability and insulation are presented. Other improvements and advantages of the adiabatic turbocompound engine are described. Preliminary hot engine performance indicates that the fuel consumption target will be met, although much work remains to be done to optimize performance. Preliminary emissions data indicate positive results; the unburned hydrocarbon and carbon monoxide emissions are almost non-existent and nitric oxide emissions are favorable. The turbocompound unit has benen thoroughly performance- and endurance-tested. The results are gratifying. Our first multi-cylinder combined adiabatic-turbocompound engine will be assembled and tested.

20850 (DOE/ET/15320—T2) **Development and engine testing of coatings on diesel engine components. Progress report, August-December 1979.** Kvernes, I. (Central Inst. for Industrial Research, Oslo (Norway)). 30 Jan 1979. Contract AC03-79ET15320. 16p. Dep. NTIS, PC A02/MF A01.

Progress in research on plasma sprayed ceramic coatings for diesel engine components is reported. Information is included on the bonding, fracture toughness, thermal isolation and microstructure characteristics of ZrO_2 coatings.

TURBINE

REFER ALSO TO CITATION(S) 20858

20851 (DOE/NASA/1011—80/4) **Parametric tests of a traction drive retrofitted to an automotive gas turbine.** Rohn, D.A.; Loewenthal, S.H.; Anderson, N.E. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center).

1980. Contract EX-76-A-31-1011. 22p. (NASA-TM—81457; CONF-800419—3). Dep. NTIS, PC A02/MF A01.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

Efficient and economical speed reducers are necessary for small, high speed, automotive type gas turbine engines. The results of a test program to retrofit a high performance fixed ratio Nasvytis Multiroller Traction Drive in place of a helical gear set to a gas turbine engine are presented. Parametric tests up to a maximum engine power turbine speed of 45,500 rpm and to a power level of 110kW were conducted. Comparisons were made to similar drives that were parametrically tested on a back-to-back test stand. The drive showed good compatibility with the gas turbine engine. Specific fuel consumption of the engine with the traction drive speed reducer installed was comparable to the original helical gearset equipped engine.

20852 (DOE/NASA/1040—80/10) **Effect of water injection and off scheduling of variable inlet guide vanes, gas generator speed, and power turbine nozzle angle on the performance of an automotive gas turbine engine.** Warren, E.L. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Mar 1980. Contract EC-77-A-31-1040. 36p. (NASA-TM—81415). Dep. NTIS, PC A03/MF A01.

In this study the Chrysler/ERDA Baseline Automotive Gas Turbine Engine was used to experimentally determine the power augmentation and emissions reductions achieved by the effect of variable compressor and power turbine geometry, water injection downstream of the compressor, and increases in gas generator speed. Results were dependent on the mode of variable geometry utilization. Over 20% increase in power was accompanied by over 5% reduction in Specific Fuel Consumption (SFC). A fuel economy improvement of at least 6% was estimated for a vehicle with a 75 kW (100 hp) engine could be augmented to 89 kW (120 hp) relative to an 89 kW (120 hp) unaugmented engine.

ELECTRIC-POWERED SYSTEMS

20853 (DOE/CS—0107) **Charge of the future: an introduction to electric and hybrid vehicles.** (Department of Energy, Washington, DC (USA). Office of Transportation Programs). Sep 1979. 75p. Dep. NTIS, PC A04/MF A01.

The past history and present development of electric vehicles are described in four sections, covering the following topics: electric vehicles today; the Congressional focus on electric and hybrid vehicles; and new directions in electric and hybrid vehicles development. In the near term, electric vehicles are neither intended nor expected to compete directly with internal combustion engine vehicles.

20854 (EPRI-EM—1245) **EPRI/SCE testing and evaluation of electric work vehicles: Jet 500, Volkswagen Type 2, DAUG Type GM2, and Battronic Minivan.** McCluskey, R.K.; Arias, J.L. (Southern California Edison Co., Rosemead (USA)). Dec 1979. 91p. Dep. NTIS, PC A05/MF A01.

During the first 11 months of the EPRI/SCE Electric Vehicle Project, four electric vehicles (EVs) were tested and evaluated: the Jet Industries Electra-Van Model 500, the Volkswagen (VW) Type 2 Electrotransporter, a VW Type GM2 Transporter with DAUG electric drive, and the Battronic Minivan. The project emphasized road-testing of these vehicles to acquire data on their useful driving range, performance, and reliability. Each vehicle was driven more than 1000 miles along SCE-selected test routes to determine the effects of different terrains (level, slight grades, and steep grades), traffic conditions (one, two, three, and four stops/mile and freeway), and payload. The vehicle component failures that occurred during testing are itemized and described briefly, and assessments of expected field reliability are made. Other vehicle characteristics and measurements of interest are presented. The data base on these test vehicles is intended to provide the reader an overview of the real world performance that can be expected from present-day state-of-the-art EVs.

20855 **Electric automobiles: energy, environmental, and economic prospects for the future.** Hamilton, W. Contract EY-76-C-03-1180. New York, NY; McGraw-Hill Inc. (1980). 446p. $24.50.

The book discusses the pros and cons of electric cars for the motorist as well as for the nation as a whole. For the motorist, it compares the prospective performance and costs of electric cars with those of conventional cars. For the nation, it projects the changes in energy use, petroleum use, air pollution, and traffic noise that would result from substituting electric cars for conventional cars. Specific projections are advanced for the years 1980, 1990, and 2000. Beginning with the reasons for the current interest in electric cars and why they have not yet come into widespread use, the book offers useful information on: prospective propulsion batteries, with projections of battery performance and capabilities; patterns for urban driving, which serve as a basis for determining the applicability of electric cars with different driving ranges and passenger capabilities; comprehensive projections of electric utility capacity and generation by fuel type, both with and without electric cars; the number of electric cars that may be recharged without adding utility capacity beyond that already planned; the requirements of electric cars for battery materials; and the impact of electric cars on urban air quality and traffic noise.

20856 (RTS—11995) **Energy meters for electric vehicles.** Brandolini, A.; Campolongo, G.; Redaelli, P. Translated from *Technol. Elettr. Int.;* No. 10, 67-72(1977). 14p. Dep. NTIS (US Sales Only), PC A02/MF A01.

The procedure used to develop a simple and totally static direct current energy meter for measuring the energy consumed by urban transit vehicles, e.g., trains, buses, subways, operated by electric traction, specifications for the energy meter, and the results of performance tests on the device are presented. (LCL)

HYBRID SYSTEMS

REFER ALSO TO CITATION(S) 20772, 20853, 20857

FLYWHEEL PROPULSION

20857 (UCRL—13982(Rev.1)) **Regenerative flywheel energy storage system.** Lustanader, E.L.; Edelfelt, I.H.; Jones, D.W.; Plunkett, A.B.; Richter, E.; Turnbull, F.G. (General Electric Co., Schenectady, NY (USA). Research and Development Center). [nd]. Contract W-7405-ENG-48. 34p. Dep. NTIS, PC A03/MF A01.

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The development, fabrication, and testing of a regenerative flywheel energy storage and recovery system for a battery/flywheel electric vehicle of the 3000 lb class are described. The vehicle propulsion system was simulated on a digital computer in order to determine the optimum system operating strategies and establish a calculated range improvement over a nonregenerative, all-electric vehicle. Fabrication of the inductor motor, flywheel, power conditioner, and system control are described. Test results of the system operating over the SAE J227a Schedule D driving cycle are given and are compared to the calculated value. The flywheel energy storage system consists of a solid rotor, synchronous, inductor-type, flywheel drive machine electrically coupled to a d-c battery electric propulsion system through a load commutated inverter. The motor/alternator unit is coupled mechanically to a small steel flywheel which provides a portion of the vehicle's accelerating energy and regenerates the vehicle's braking energy. The laboratory simulation of the electric vehicle propulsion system includes a 108-volt, lead-acid battery bank and a separately excited d-c propulsion motor coupled to a flywheel which simulates the vehicle's inertia.

VEHICLE DESIGN FACTORS

REFER ALSO TO CITATION(S) 20452

EMISSION CONTROL

REFER ALSO TO CITATION(S) 20847, 20852

20858 (AD-A—073114) **The criticality of engine exhaust simulations on VSTOL model-measured ground effects. Final report Jul 1978-Aug 1979.** Lummus, J.R. (General Dynamics/Fort Worth, TX (USA)). Jul 1979. Contract N00014-78-C-0384. 112p. NTIS, PC A06/MF A01.

This experimental investigation demonstrated the criticality of performing accurate full-scale engine exhaust simulations during model-measured VSTOL ground effects testing. The effects of varying the nozzle exit turbulence, total pressure distributions, and nozzle pressure ratio on the net and component ground-induced forces for two-, three-, and four-nozzle configurations with large blocking surfaces (as well as a smaller, cruciform two-nozzle blocking surface more characteristic of a real aircraft planform) were studied.

20859 (PB—299048) **Report on requests by General Motors and Ford to reduce fuel econoMY standards for my 1981-85 passenger automobiles. Final report.** (National Highway Traffic Safety Administration, Washington, DC (USA)). Jun 1979. 89p. NTIS, PC A05/MF A01.

The 1981-84 Fuel Economy Standards for Passenger Automobiles were issued in June, 1977. However, in December, 1978 General Motors and Ford began claiming that reduced standards would result in a slower rate of car price increases that would save

consumers money. After a review of the GM and Ford information the NHTSA concluded that initiating rulemaking to reduce the standards was not warranted.

NITROGEN OXIDES

20860 (PB—80-102759) **Mobile source NO/sub x/ monitor, hydrogen-atom direct chemiluminescence method. Final report, September 1977-March 1979.** Fontijn, A.; Volltrauer, H.N.; Frenchu, W.R. (AeroChem Research Labs., Inc., Princeton, NJ (USA)). Jul 1979. Contract EPA-68-02-2744. 43p. NTIS, PC A03/MF A01.

An analyzer was developed for measuring motor vehicle NOx (NO and NO_2) emissions based on the chemiluminescence reaction of NO and NO_2 with hydrogen atoms. This eliminated the need for an NO_2 to NO converter as required with ozone chemiluminescence for NOx analysis. The hydrogen-atom source is based on the thermal dissociation of molecular hydrogen on a hot (approximately 1900C) tungsten filament. The unit has linear response to NOx over a concentration range from 4 ppM to greater than 3000 ppM. No interferences were observed with H_2O, CO, CO_2, toluene, isopentane, NH_3, HCN, CH_3NH_2, or H_2 at concentrations encountered in raw automobile exhaust. Oxygen and ethylene caused minor interferences which should be inconsequential in actual application.

HYDROCARBONS

20861 (LBL—8819) **Studies of wall flame quenching and hydrocarbon emissions in a model spark ignition engine.** Ishikawa, N. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1978. Contract W-7405-ENG-48. 106p. Dep. NTIS, PC A06/MF A01.

Thesis.

The imposition of stringent motor vehicle emission standards combined with the recent demand for increased fuel economy have led to renewed interest in operating automobile engines with very lean mixtures. But, the potential for reduction of pollutants by lean combustion is lessened by increased hydrocarbon emissions. Unburned hydrocarbon formation due to wall flame quenching was studied in order to observe the wall flame quenching process, combustion processes, and flow characteristics in an engine under various conditions to obtain qualitative information for clarifying wall flame quenching mechanisms and to contribute to better design of engines to reduce hydrocarbon emissions. Effects of geometry, equivalence ratio, and ignition timing on the unburned hydrocarbon formation were examined. The experiments were conducted using a model spark ignition engine. Methane was used as the fuel. Initial conditions were at atmospheric pressure and at room temperature for all cases. Five pistons with different geometries were used in an attempt to examine the flow variations. The major results were: a quench layer was observed along the cylinder walls and its thickness was of the same order of magnitude as that of local thermal boundary layer; piston geometry and the intake process can drastically modify the flow characteristics in an engine; the rolled-up vortex plays an important role in generating wall turbulence and the process of exhausting unburned hydrocarbons; wall turbulence strongly affects the quenching process, increasing unburned hydrocarbons; and retarded ignition timing increased and unburned hydrocarbons. The main conclusions are that wall turbulence can significantly increase the effective quench layer thickness and that the key to minimizing wall flame quenching is to reduce turbulence generated near the engine cylinder walls.

ALTERNATIVE FUELS

REFER ALSO TO CITATION(S) 20806

20862 (DOE-tr—213) **Technico-economic study for the utilization of methanol and hydrogen for highway transportation. Volume 1. Methanol.** Feb 1978. Translation source information not available. 219p. Dep. NTIS, PC A10/MF A01.

The adjustments that should be considered with regard to the present gasoline distribution system as well as to the design of engines so as to permit the use of methanol-based fuels are examined. Scenarios for obtaining and dispatching methanol-based fuels, especially alcohol itself, from the production facility to the pump are analyzed. Each of these distribution stages is analyzed from a technico-economic viewpoint which permits calculation of transportation costs by sea, on rivers, and by land as well as intermediate storage costs. The last stage is concerned with a type of service station that is capable of supplying vehicles that are properly equipped or adjusted to operate with methanol-based fuels. The resulting data allow a general comparison to be made between conventional fuels and fuels based on methanol (pure alcohol and a 15% mixture by volume). (MOW)

MATERIALS

REFER ALSO TO CITATION(S) 20019

METALS AND ALLOYS

REFER ALSO TO CITATION(S) 19903, 19936, 20542, 20543, 20545, 20557, 20916

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 20710, 20878, 21458

20863 (CONF-791112—54) **Macroscopic theory of pulsed laser annealing.** Wood, R.F.; Wang, J.C.; Giles, G.E.; Kirkpatrick, J.R. (Oak Ridge National Lab., TN (USA)). Dec 1979. Contract W-7405-ENG-26. 19p. Dep. NTIS, PC A02/MF A01.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1979).

Radiation from high-power Q-switched lasers has been used recently in semiconductor research to anneal the lattice damage caused by ion implantation, diffuse surface-deposited dopant films, recrystallize doped amorphous films deposited on substrates, and remove precipitates present after conventional high-temperature dopant diffusion. All of these processes can be understood in terms of models based on macroscopic diffusion equations for heat and mass transport, cast in a finite-difference form to allow for the temperature- and spatial-dependence of the thermal conductivity, absorption coefficient, reflectivity, and other quantities. Results of calculations on silicon with the models show that the near-surface region of a sample can melt and stay molten for times of the order of 100 nsec during which dopant diffusion in the liquid state and nonequilibrium segregation during ultrarapid recrystallization are sufficient to explain the major features of the experimental results. Brief descriptions of the physical and mathematical models and some of the results obtained with them are given, with particular emphasis on segregation effects.

20864 (CONF-791112—56) **Surface segregation in laser annealing of ion implanted silicon.** White, C.W.; Wilson, S.R.; Appleton, B.R.; Narayan, J. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 6p. Dep. NTIS, PC A02/MF A01.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1979).

Profiles for Group III and V dopants after pulsed laser annealing are calculated using a model which incorporates dopant diffusion in the liquid and a segregation coefficient from the melt. Values for the interfacial distribution coefficient are much higher than equilibrium values. Non Group (III, V) impurities exhibit segregation which is a function of implantation dose and number of annealing pulses. At high doses, all species which exhibit segregation develop a cell structure in the surface region as a result of constitutional supercooling. We estimate the thermal gradient in the liquid necessary to produce consitutional supercooling.

20865 (CONF-791112—59) **Melting by pulsed laser irradiation.** Narayan, J.; White, C.W. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 5p. Dep. NTIS, PC A02/MF A01.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1979).

The phenomenon of melting produced by pulsed ruby-laser ($\lambda = 0.694\ \mu m$) irradiation has been investigated. Removal of dopant precipitates, dislocations, and loops during laser irradiation provides clear evidence of melting. The depth of melting can be determined as a function of laser parameters (energy density and pulse duration) from the thickness of defect-free regions and lengths of reoriented dislocation segments.

20866 **Method for joining metal by solid-state bonding.** Burkhart, L.E.; Fultz, C.R.; Maulden, K.A. (to Dept. of Energy). US Patent 4,163,516. 7 Aug 1979. Filed date 28 Dec 1977. 6p.

PAT-APPL-865,360.

A method is described for joining metal at relatively low temperatures by solid-state bonding. Planar surfaces of the metal workpieces are placed in a parallel abutting relationship with one another. A load is applied to at least one of the workpieces for forcing the workpieces together while one of the workpieces is relatively slowly oscillated in a rotary motion over a distance of about 1^0. After a preselected number of oscillations, the rotary motion is terminated and the bond between the abutting surfaces is effected. An additional load may be applied to facilitate the bond after terminating the rotary motion. 3 claims.

20867 Ferritic Fe-Mn alloy for cryogenic applications. Hwang, S.K.; Morris, J.W. Jr. (to Dept. of Energy). US Patent 4,162,158. 24 Jul 1979. Filed date 28 Dec 1978. 4p.

PAT-APPL-973,844.

A ferritic, nickel-free alloy steel composition, suitable for cryogenic applications, which consists essentially of about 10 to 13% manganese, 0.002 to 0.01% boron, 0.1 to 0.5% titanium, 0 to 0.05% aluminum, and the remainder iron and incidental impurities normally associated therewith. 2 claims.

20868 Secondary hardening steel having improved combination of hardness and toughness. Parker, E.R.; Zackay, V.F.; Bhat, M.S.; Garrison, W.M. Jr. (to Dept. of Energy). US Patent 4,162,157. 24 Jul 1979. Filed date 15 May 1978. 6p.

PAT-APPL-906,308.

A secondary hardening alloy steel composition consisting essentially of about 0.25 to 0.5% carbon, about 0.5 to 1.0% manganese, about 1.5 to 3.0% nickel, about 0 to 1.0% chromium, about 1.75 to 2.5% molybdenum, about 0 to 0.4% vanadium, and an additive selected from about 1 to 3% aluminum and a combination of at least about 1% aluminum and at least about 1% silicon for a combined Al + Si content of about 2 to 4%, the balance being iron and impurity elements. The present steel composition has the following characteristics: it exhibits a flat tempering response, it is hardenable upon tempering to a Rockwell C hardness of at least 50, and it has an improved combination of hardness vs toughness properties after tempering in the secondary hardening range. A method of preparation is also described. 8 claims.

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 20863, 20865, 20879, 20880, 20881, 20886, 20890, 20896, 20908

20869 (CONF-800205—10) **Development of microstructural features during irradiation.** Wiedersich, H. (Argonne National Lab., IL (USA)). 1980. Contract W-31-109-ENG-38. 33p. Dep. NTIS, PC A03/MF A01.

From American Institute of Metallurgical Engineers meeting; Las Vegas, NV, USA (Feb 1980).

Portions of this document are illegible.

During elevated temperature irradiation with energetic neutrons, ions or electrons, the microstructure of alloys undergoes significant changes accompanied by corresponding changes in physical properties. The microstructural development is caused by the defect production throughout the material and the concurrent annihilation of the mobile point defects and small defect clusters on spatially discrete sinks such as dislocations, grain boundaries and voids. We review here the present understanding of the development of the radiation microstructure beyond the nucleation stage of stable defect clusters. After a short characterization of the dynamic state of a crystalline material during elevated temperature irradiation we discuss (a) the void swelling phenomenon; (b) radiation-enhanced, diffusion controlled processes such as precipitate coarsening; and (c) radiation-induced processes such as radiation-induced precipitation and spatial redistribution of phases in multiphase alloys.

20870 (CONF-800231—2) **Deviation of longitudinal and shear waves in austenitic stainless steel weld metal.** Kupperman, D.S.; Reimann, K.J. (Argonne National Lab., IL (USA)). 1980. Contract W-31-109-ENG-38. 16p. Dep. NTIS, PC A02/MF A01.

From 3. international conference on nondestructive evaluation in the nuclear industry; Salt Lake City, UT, USA (11 Feb 1980).

One of the difficulties associated with the ultrasonic inspection of stainless steel weld metal is the deviation of the ultrasonic beams. This can lead to errors in determining both the location and size of reflectors. The present paper compares experimental and theoretical data related to beam steering for longitudinal and shear waves in a sample of 308 SS weld metal. Agreement between predicted and measured beam deviations is generally good. Reasons for discrepancies are discussed.

20871 Long-period superlattices in the copper-gold system as two-phase mixtures. Williams, R.O. (Oak Ridge National Lab., TN). *Metall. Trans., A;* **11**: No. 2, 247-253(Feb 1980).

It is shown that a coherent two-phase mixture of ordered Cu_3Au and the solid solution is better able to account for the observations on the complex structure (a long-period superlattice) which forms in the two-phase field around 30 at. pct Au than the structure proposed by Scott. In this structure, the antiphase boundaries was replaced in Scott's structure with a few layers of the solid solution. In some measure it is the interfacial and the elastic coherency energies that are responsible for the details of this structure. These effects cause the observed two-phase field to be only 2.5 at. pct wide, compared with 10 pct for the equilibrium two-phase field. A model was constructed that explains how this structure forms. From these results most of the so-called long-period superlattices are really two-phase mixtures of similar geometry. More generally, many of the complex, closely spaced phases that have been observed in some alloy systems can be similarily interpreted when the required analysis is carried out. In particular, the conclusions concerning the Fe-Al system are of a distinctly different character than those of Allen and Cahn.

20872 Compositional analysis of dual phase steels by transmission electron microscopy. Koo, J.Y. (Rutgers Univ., Piscataway, NJ); Raghavan, M.; Thomas, G. Contract W-7405-ENG-48. *Metall. Trans., A;* **11**: No. 2, 351-355(Feb 1980).

Complementary techniques of high resolution lattice imaging and scanning transmission electron microscopy with x-ray energy dispersive capability were used to provide localized chemical composition in alloys through correlation of lattice fringe spacing with composition. This information is important in developing a better understanding of microstructure-mechanical property relationship in dual phase steels, especially to fine scale precipitation in ferrite. (FS)

20873 Positron annihilation: a localized probe of lattice defects in metals. Siegel, R.W. (Argonne National Lab., IL). *Scr. Metall.;* **14**: No. 1, 15-22(Jan 1980).

Recent advances in positron annihilation as a localized, lattice defect probe in metals are reported. Positron annihilation spectroscopy (PAS) is shown to be a valuable technique to localize metal defects and electronic environment. (FS)

20874 Reply to a criticism of a paper regarding martensitic behavior of α-phase uranium. Sandenaw, T.A. (Los Alamos Scientific Lab., NM). *Scr. Metall.;* **12**: 959(1978).

A comment (1) has been made concerning statements made in a paper entitled Variable Low-Temperature Martensitic Behavior of α-Phase Uranium (2). The following technical note is presented as a reply to that comment.

20875 Spectrum of binding energies approach to grain boundary segregation. White, C.L.; Coghlan, W.A. (Oak Ridge National Lab., TN). *Metall. Trans., A;* **8**: 1403-1412(Sep 1977).

From Symposium on fundamentals of grain boundary segregation; Niagara Falls, NY, USA (21 Sep 1976).

Experimental data on the temperature dependence of solute segregation to grain boundaries in polycrystalline metals does not appear to be adequately explained by a single binding energy between solute atoms and grain boundary sites. The extent of segregation in a given alloy appears to decrease more slowly with increasing temperature than is consistent with a theory based on such a single binding energy. This behavior can be explained however, if a spectrum of binding energies is assumed to exist. Such a binding energy spectrum presumably results from the site-to-site variation in the solute environment at the grain boundary. The present paper considers the elastic interaction between solute atoms and tilt boundaries in order to estimate the spectrum of binding energies for such boundaries. The extent of solute segregation to these boundaries is then calculated for several sets of parameters that determine the nature of the solute and the grain boundary.

20876 (RFP-Trans—257) **Modification of Al-Si alloys: comparative studies on the use of salt mixtures, metallic sodium and modifiers which react exothermally.** Riedelbach, H.; Stoffregen, K.W.; Hielscher, U. Translated from *Fonderie;* No. 335, 257-263(1974). 12p. Dep. NTIS, PC A02/MF A01.

Test results are summarized as follows: the salt mixtures normally used necessitate a reaction time and temperature corresponding to their composition, otherwise the modification effect is inadequate. Salt mixtures with low reactivity and therefore poor in sodium fluoride are superior to those which contain a larger quantity. Sodium metal is a very effective modifying agent for intermediate and high temperatures, provided the problems of conservation and handling can be overcome. The yield as modifier for a particular quantity added increases with temperature. Modification in a relatively broad temperature range can be obtained with exothermally reacting tablets. They act rapidly and very regularly. They assure a good sodium yield, which increases still more as the temperature rises. From a comparison of all the modifying agents tested, it turns out that the exothermally reacting tablets are specially advantageous. Treatment of modified baths by bubbling gas can be employed successfully with nitrogen or with products which liberate nitrogen. The sodium loss, which is inevitable, can be compensated for by over-modification or by using products which liberate both nitrogen and sodium in the bath.

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 20029, 20556, 20599, 20625, 20868, 20872, 20906, 20909

20877 (ANL—79-92) **Effects of environment on the low-cycle fatigue behavior of Type 304 stainless steel.** Maiya, P.S.; Burke, W.F. (Argonne National Lab., IL (USA)). Dec 1979. Contract W-31-109-ENG-38. 19p. Dep. NTIS, PC A02/MF A01.

The low-cycle fatigue behavior of Type 304 stainless steel has been investigated at 593°C in a dynamic vacuum of better than 1.3 x 10^{-6} Pa (10^{-8} torr). The results concerning the effects of strain range, strain rate and tensile hold time on fatigue life are presented and compared with results of similar tests performed in air and sodium environments. Under continuous symmetrical cycling, fatigue life is significantly longer in vacuum than in air; in the low strain range regime, the effect of sodium on fatigue life appears to be similar to that of vacuum. Strain rate (or frequency) strongly influences fatigue life in both air and vacuum. In compressive hold-time tests, the effect of environment on life is similar to that in a continuous-cycling test. However, tensile hold times are nearly as damaging in vacuum as in air. Thus, at least for austenitic stainless steels, the influence of the environment of fatigue life appears to depend on the loading wave-shape.

20878 (CONF-771140—6) **Residual elements have significant effects on the elevated-temperature properties of austenitic stainless steel welds.** Edmonds, D.P.; King, R.T.; Goodwin, G.M. (Oak Ridge National Lab., TN (USA)). 1977. Contract W-7405-ENG-26. 11p. Dep. NTIS, PC A02/MF A01.

From ASTM symposium on the influence of carbon, nitrogen, and residual element chemistry on the behavior of austenitic stainless steels used in construction; Atlanta, GA, USA (14 Nov 1977).

The influence of various residual elements on the elevated-temperature properties of austenitic stainless steel welds was investigated. Included in this investigation are the effects of B, P, Ti, C, S, and Si. This work is aimed at developing austenitic stainless steel weld materials with enhanced elevated-temperature properties. The materials investigated in this program include types 308, 316, 16-8-2 stainless steel weld metals. Processes investigated include shielded metal-arc (SMA), gas tungsten-arc (GTA), and submerged-arc (SA) welding. Early work was done with type 308 and 316 SMA weld metals where the greatest enhancement of properties resulted from controlled additions of boron, phosphorus, and titanium to the deposits. Significant improvements in the properties of GTA and SA welds also result from the addition of these residual elements. The optimum residual element compositions were determined to be nominally 0.05% Ti, 0.04% P, and 0.006% B for SMA welds and 0.5% Ti, 0.04% P, and 0.006 B for GTA welds. Submerged-arc welds with 0.2% Ti have exhibited improved creep strengths for all three materials.

20879 (COO—2975-34) **Advanced Gas-Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, April 1, 1979-June 30, 1979.** (General Electric Co., Schenectady, NY (USA). Energy Systems Programs Dept.). 25 Jan 1980. Contract EY-76-C-02-2975. 37p. Dep. NTIS, PC A03/MF A01.

The results are presented of work performed on the Advanced Gas-Cooled Nuclear Reactor Materials Evaluation and Development Program. The objectives of this program are to evaluate candidate alloys for Very High Temperature Reactor (VHTR) Nuclear Process Heat (NPH) and Direct Cycle Helium Turbine (DCHT) applications, in terms of the effect of simulated reactor primary coolant (helium containing small amounts of various other gases), high temperatures, and long time exposures, on the mechanical properties and structural and surface stability of selected candidate alloys. A second objective is to select and recommend materials for future test facilities and more extensive qualification programs. Work covered in this report includes the activities associated with the status of the simulated reactor helium supply system, testing equipment, and gas chemistry analysis instrumentation and equipment. The status of the data management system is presented. In addition, the progress in the screening test program is described.

20880 (COO—3166-30) **Environment and fracture. Progress report.** Johnson, H.H. (Cornell Univ., Ithaca, NY (USA). Dept. of Materials Science and Engineering). Mar 1979. Contract EY-76-S-02-3166. 31p. Dep. NTIS, PC A03/MF A01.

Results are presented of an investigation of hydrogen trapping in iron and iron base alloys. Both physical and chemical trapping were studied. Chemical trapping of H is found in H attack of plain carbon and alloy steels. Diffusion H reacts with carbon to form methane which leads to deterioration of microstructure, and degradation of mechanical properties. Physical trapping of H is evident at lower temperatures. (FS)

20881 (DOE/ER/10433—1) **Microstructural approach to fatigue crack processes in polycrystalline bcc materials. Annual technical progress report I.** Gerberich, W.W. (Minnesota Univ., Minneapolis (USA). Dept. of Chemical Engineering and Materials Science). 1 Apr 1980. Contract AC02-79ER10433. 30p. Dep. NTIS, PC A03/MF A01.

Two commercial low-alloy high-strength steels, four Fe-base alloys, and Ti-30 Mo were evaluated. Dislocation dynamics, strain-rate sensitivity and fatigue and fracture characterization were studied. (FS)

20882 (DP-MS—79-61) **Hydrogen assisted fracture of sensitized Type 304L austenitic stainless steel.** Caskey, G.R. Jr. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1980. Contract EY-76-C-09-0001. 25p. (CONF-800205—5). Dep. NTIS, PC A02/MF A01.

From American Institute of Metallurgical Engineers meeting; Las Vegas, NV, USA (Feb 1980).

Sensitized specimens of Type 304L stainless steel were tensile tested in atmospheres of hydrogen and helium at high pressure, and in air at ambient pressure. Comparison tensile tests were made with solution-annealed specimens of Type 304L stainless steel in the same atmosphere. When both specimens were tested in high-pressure hydrogen, the sensitized specimens had greater loss in ductility and increased tendency to intergranular fracture. For the sensitized specimens, plastic strain to failure (ϵ/sub p/ = ln A_o/A/sub f/) in hydrogen at 69 MPa was reduced by 60 to 70% in comparison to similar tests in helium. In addition, a notch with a stress concentration factor of about 3 reduced plastic strain an additional 50 to 60%. In all cases, the nominal tensile strength of Type 304L stainless steel was increased by the notch. There was no evidence of intergranular failure in notched specimens of solution-annealed Type 304L stainless steel tested in high-pressure hydrogen environments.

20883 (LA-UR—80-635(Rev.)) **Using diffusion measurements to determine pore-size distributions in porous materials.** Brown, L.F.; Travis, B.J. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 19p. (CONF-800610—5). Dep. NTIS, PC A02/MF A01.

From American Institute of Chemical Engineering conference; Philadelphia, PA, USA (8 Jun 1980).

A method for determining pore-size distrbutions from diffusion measurements is presented. A Wicke-Kallenbach experiment, for measuring diffusion fluxes within porous materials, was carried out over a significant portion of the transition range between Knudsen flow and bulk diffusion. If the internal porous structure of the material is modeled as myriad nonintersecting cylindrical pores, an equation may be derived for the flux as a function of pressure, in which the flux is a functional of the pore-size distribution. The equation is a Fredholm integral equation of the first kind. This is an application of the general inversion problem, and solution of the equation for the pore-size distribution is possible. It is demonstrated from calculated fluxes using postulated ideal distributions that the method works very well for both unimodal and bimodal distributions. The method is no extraordinarily sensitivire to experimental error. An example of a distribution obtained from a commercial porous catalyst is presented and compared with that obtained by mercury porosimetry.

20884 (ORNL—5616) **Metallurgical and mechanical properties of thorium-doped Ir-0.3% W alloys.** Liu, C.T.; Inouye, H.; Schaffhauser, A.C. (Oak Ridge National Lab., TN (USA)). Apr 1980. Contract W-7405-ENG-26. 22p. Dep. NTIS, PC A02/MF A01.

Metallurgical and mechanical properties of Ir-0.3% W alloys have been studied as a function of thorium concentration in the range 0 to 1000 ppM by weight. The solubility limit of thorium in Ir-0.3% W is below 30 ppM. Above this limit, the excess thorium reacts with iridium to form second-phase particles. Thorium additions raise the recrystallization temperature and effectively retard grain growth at high temperatures. Tensile tests at 650°C show that the alloy without thorium additions (undoped alloy) fractured by grainboundary (GB) separation, while the alloys doped with less than 500 ppM thorium failed mainly by transgranular fracture at 650°C. Intergranuiar fracture in the doped alloys is suppressed by GB segregation of thorium, which improves the mechanical properties of the boundary. The impact properties of the alloys were correlated with test temperature, grain size, and heat treatment. The impact ductility increases with test temperature and decreases with grain size. For a given grain size, particularly in the fine-grain size range, the thorium-doped alloys are much more ductile and resistant to GB fracture. All of these results can be correlated on the basis of stress concentration on GBs by using a dislocation pileup model.

20885 (SAND—80-0748C) **Theory for laminated plates with a through-the-thickeness crack.** Chen, E.P. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 20p. (CONF-800357—1). Dep. NTIS, PC A02/MF A01.

From 5. international conference on fracture; Cannes, France (29 Mar 1980).

The flexural response of a laminated plate with a through-the-thickness crack was considered in this investigation. A laminated plate theory of the Reissner type has been developed to treat this problem. For demonstration purposes, the theory was applied to a balanced symmetric laminate which contains a through-the-thickness central crack. The stress intensity factor for the crack was determined and the influences of the various material and geremetric parameters on the stress intensity factor were discussed.

20886 (SAND—80-6004) **Third All-Union symposium on impulsive pressures. Summaries of reports.** Batsanov, S.S. (ed.). 11 Mar

1980. Translation of Third All-Union symposium on impulsive pressures; Moscow, USSR, October 16-18, 1979. (CONF-7910143—(Summ.)). 239p. Dep. NTIS, PC A11/MF A01.

From 3. all-union symposium on impulsive pressures; Moscow, USSR (16 Oct 1979).

The abridged contents of reports delivered at the Third All-Union Symposium on Impulsive Pressures (Moscow, October 16-18, 1979) are presented in these summaries. The summaries of these reports involve new methods and means of shock-wave measurement, theoretical questions and physical experiments in the dynamic pressure region, the results of physiochemical investigations of substances and materials subjected to explosive treatment, and various aspects of the applicaton of dynamic methods for solution of technical and technological problems.

20887 Effects of helium on the mechanical properties and microstructure of niobium. Barmore, W.L.; Echer, C.J.; Raymond, E.L.; Vandervoort, R.R. (Univ. of California, Livermore). Contract W-7405-ENG-48. *Metall. Trans., A;* **11**: No. 2, 239-245(Feb 1980).

Mechanical property specimens of niobium (Cb) were doped with helium by the tritium trick to concentrations as high as 500 appm. The tritium decays by the reaction $^3H \rightarrow {}^3He + \beta^-$ at a rate that produces about 7 appm per day in the host microstructure. Tensile properties were measured from room temperature to 800°C, and creep properties from 700 to 1000°C at stresses from 45 to 75 MPa. Transmission electron microscopy was used to study the microstructure of the helium doped specimens, and the observations were correlated with the mechanical property results. The results of this investigation showed that niobium has a high tolerance to helium trapped in the microstructure. The tensile and creep strengths of niobium increased as helium concentration increased. The ductility decreased significantly as the helium concentration increased, but niobium retained substantial ductility even at a high helium concentration of 500 appm. This amount of helium would be generated by (n,α) reactions in the microstructure of a niobium first wall after a 20 y exposure in a D-T fusion reactor. Thus, niobium and niobium alloys are potential candidates for high temperature structural materials in D-T fusion reactors.

20888 Utility of positrons for studies of metals and alloys. Byrne, J.G. (Univn of Utah, Salt Lake City). *Scr. Metall.;* **14**: No. 1, 3-7(Jan 1980).

The utility of positron annihilation is illustrated by rapid bending in high cycle fatigue of polycrystals, slow bending of oriented single crystals, and H effects and precipitation hardening effects. It is shown that positron measurement provides clear nondestructive indication's of changes in the state of a material. (FS)

20889 Proposed cyclic cleavage crack growth model for fatigue of BCC iron and its alloys. Gerberich, W.W.; Moody, N.R.; Jatavallabhula, K. (Univ. of Minnesota, Minneapolis). *Scr. Metall.;* **14**: No. 1, 113-q18(Jan 1980).

Work in progress to define in detail the microscopic growth process in Fe, Fe-Ni, and Fe-Si at temperature below their ductile-brittle transition is described. (FS)

20890 Fracture mode transition of iron in hydrogen as a function of grain boundary sulfur. Bruemmer, S.M.; Jones, R.H.; Thomas, M.T.; Baer, D.R. (Battele Pacific Northwest Labs., Richland, WA). Contract CY-76-C-06-1830. *Scr. Metall.;* **14**: No. 1, 137-141(Jan 1980).

Embrittlement of iron of variable impurity levels and identical thermal histories was shown to be dependent on the sulfur enrichment at grain interfaces and the applied cathodic potential. A fracture mode transition from transgranular ductile rupture to brittle intergranular failure was observed as a function of the grain boundary sulfur concentration. This mode change causes a dramatic loss in ductility at a threshold sulfur content of about 13% of monolayer on the fracture surface. A relationship is suggested between the roles S and H play in reducing boundary strength in iron.

20891 Independent and sequential cavity growth mechanisms. Miller, D.A.; Langdon, T.G. (Univ. of Southern California, Los Angeles). *Scr. Metall.;* **14**: No. 1, 143-148(Jan 1980).

There are three distinct processes of cavity growth: power-law creep growth, and unconstrained and constrained grain boundary diffusion growth. A unified approach may be developed for these three processes by using the principles already established for independent and sequential creep mechanisms. On a logarithmic plot of cavity growth rate vs stress, unconstrained diffusion growth with a slope of 1 occurs over only a limited range of intermediate stresses, and there are transitions to a slope of n (the stress exponent for matrix deformation) at both high (power-law creep growth) and low constrained diffusion growth) stress levels. On a logarithmic plot of the time to fracture vs stress, unconstrained diffusion growth with a slope of -1 occurs over a limited intermediate region, and there are transitions to a slope of -n at both high (power-law creep growth) and low (constrained diffusion growth) stress levels. The values obtained experimentally for the times to fracture may be either substantially larger (at low stresses) or substantially smaller (at high stresses) than the values predicted by the theory for unconstrained diffusion growth. The predictions arising from this analysis are consistent with recent experimental data.

20892 Neutron irradiation-induced defect structures in zirconium. Jostsons, A.; Kelly, P.M.; Blake, R.G.; Farrell, K. (Aust At Energy Comm Res Establ, Lucas Heights, NSW). *Am. Soc. Test. Mater., Spec. Tech. Publ.;* No. 683, 46-61(1978).

From 9. international symposium on the effects of radiation on structural materials; Richland, Washington, USA (11 Jul 1978).

A transmission electron microscope (TEM) was used to study the neutron irradiation-induced defect structures in zirconium from various sources irradiated to fluences up to $1.3*10^{25}$ neutrons (n)/m^{-2} >0.1 MeV and temperatures in the range 478 to 823 K. Below 673 K the predominant form of damage consists of dislocation loops. At higher irradiation temperatures, depending on specimen purity, the defects may include faulted loops and voids in addition to the perfect loops. The temperature regime of the stability of the various defects was defined. Quantitative measurements showing the effect of irradiation temperature and specimen purity are presented and discussed. 21 refs.

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 20537, 20864, 20884, 20898, 21454

20893 (CONF-800427—2) Tritium permeability of structural materials and surface effects on permeation rates. Bell, J.T.; Redman, J.D.; Bittner, H.F. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 19p. Dep. NTIS, PC A02/MF A01.

From Tritium technology in fission, fusion, and isotopic application; Dayton, OH, USA (29 Apr 1980).

Tritium management in any system always will include containment such that tritium release rates will be less than established limits and also will be as low as practical. The well known properties of hydrogen to permeate through most materials make the complete containment of tritium an impossible task. However, tritium release rates from a given system can be minimized by two primary efforts. First is the selection of a compatible containment material which frequently also will be the structural material. This effort should include films and barriers that would be compatible with the structural material. Second and sometimes more important, the material should have surface chemistry in the particular system that continuously impedes tritium permeation.

20894 (LBL—10322) Overlay coatings for gas turbine airfoils. Boone, D.H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1979. Contract W-7405-ENG-48. 34p. Dep. NTIS, PC A03/MF A01.

The present understanding of the degradation modes associated with gas turbine operation under a variety of conditions is reviewed as a preliminary to defining the needs of protective airfoil coatings and processing techniques. These requirements and present coating procedures are briefly described as an introduction to the need for overlay type coatings in general and electron beam (EB) evaporation processed coatings in particular. A discussion of the features of production EB coaters is followed by a detailed description of the individual coating processing steps involved. While most are identical to other coating procedures, a few are significantly different and are discussed in detail. A review of the understanding of current overlay coating compositions and their use-experience is followed by a brief discussion of future directions in overlay coating processing and compositions including electron beam-physical vapor deposition (EB-PVD) applied ceramics.

20895 (SAND—79-0645) Metal tritides helium emission. Beavis, L.C. (Sandia Labs., Albuquerque, NM (USA)). Feb 1980. Contract EY-76-C-04-0789. 35p. Dep. NTIS, PC A03/MF A01.

Over the past several years, we have been measuring the release of helium from metal tritides (primarily erbium tritide). We find that qualitatively all tritides of interest to us behave the same. When they are first formed, the helium is released at a low rate that appears to be related to the amount of surface area which has access to the outside of the material (either film or bulk). For example, erbium tritide films initially release about 0.3% of the helium generated. Most tritide films emit helium at about this rate initially. At some later time, which depends upon the amount of helium generated, the parent occluding element and the degree of tritium saturation of the dihydride phase the helium emission changes to a new mode in which it is released at approximately the rate at which it is generated (for example, we measure this value to be ≈ .31 He/Er for $ErT_{1.9}$ films). If erbium ditritide is saturated beyond 1.9 T/Er, the critical helium/metal ratio decreases. For example, in bulk powders $ErT_{2.15}$ reaches critical release concentration at ≈ 0.03. Moderate elevation of temperature above room temperature has little impact on the helium release rate. It appears that the process may have ≈ 2 kcal/mol activation energy. The first helium formed

is well bound. As the tritide ages, the helium is found in higher energy sites. Similar but less extensive measurements on scandium, titanium, and zirconium tritides are also described. Finally, the thermal desorption of erbium tritides of various ages from 50 days to 3154 days is discussed. Significant helium is desorbed along with the tritium in all but the youngest samples during thermodesorption.

20896 **Slow-positron studies on metals.** Lynn, K.G. (Brookhaven National Lab., Upton, NY). Contract EY-76-C-02-0016. *Scr. Metall.;* **14**: No. 1, 9-14(Jan 1980).

Experimental aspects of slow positron beams, general features of positron interaction with surfaces, Ps formation at surfaces, re-emission of slow positrons from metallic surfaces and trapping of positrons at near surface defects are discussed. (FS)

CORROSION AND EROSION

REFER ALSO TO CITATION(S) 19911, 19971, 19976, 20237, 20238, 20332, 20535, 20536, 20538, 20539, 20540, 20541, 20544, 20546, 20547, 20616, 20760, 20879, 21004, 21044, 21513

20897 (CONF-790749—, pp 331-339) **Hot corrosion of high temperature alloys.** Stringer, J. (Electric Power Research Inst., Palo Alto, CA). Dec 1979.

From Conference on advanced materials for alternate fuel capable directly fired heat engines; Castine, ME, USA (30 Jul 1979).

Many different deposits can result in enhanced corrosion of metals and alloys. A well-documented example is sodium sulfate induced attack, but it has been shown that at least three modes of propagation exist; these may participate at different times in the corrosion of the same component. These reactions can be affected by other contituents of the deposit, which may make the salt more acid or more basic; or they may lower the melting point, or perhaps the viscosity, making it easier for the salt to penetrate porous scale layers. They may change the chemistry by forming complexes which then interact with the sodium sulfate producing low melting points or more acid mixtures in the presence of other constituents such as SO_3 in the gas stream. They may lower the oxygen activity in the sulfate, thus increasing the sulfur activity and promoting sulfidation; carbon deposits may act in this way. Initiation of enhanced corrosion probably requires the partial removal of a protective oxide layer. In addition to fluxing reactions, mechanical strains induced either by straining the specimen directly or by thermal cycling may fracture the scale, allowing molten salt access to the metal surface. Erosion may also remove the scale. Sodium chloride may remove a protective scale, perhaps by reducing the scale/metal adhesion. In terms of alternate fuels, it is easy to see that the alkali metal content and the sulfur content are important. Elements known to produce adverse effects include vanadium, lead, phosphorus, and chlorine.

20898 (CONF-800401—5) **Emissivity of sodium wetted and oxidized Type 304 stainless steel.** Haines, N.L.; Craig, R.E.; Forsyth, D.R.; Novendstern, E.H. (Westinghouse Electric Corp., Madison, PA (USA). Advanced Reactors Div.). 1980. Contract AC15-76CL02395. 7p. Dep. NTIS, PC A02/MF A01.

From 2. international conference of liquid metal technology for energy systems; Richland, WA, USA (20 Apr 1980).

The emissivity of sodium wetted and oxidized Type 304 stainless steel was determined to provide data for calculating the heat flow through Liquid Metal Fast Breeder Reactor (LMFBR) reflector plates, located above the sodium pool, to the reactor closure head. An emissivity experiment using a Type 304 stainless steel specimen was performed in an inerted glovebox. Relatively high oxygen concentrations of 10,000 and 50 vppm were used in the argon/oxygen mixtures to reduce reaction time. Following wetting and oxidation, the specimen was heated to a maximum temperature of 450°C and the emissivity of the oxidized coating was calculated. Results indicate that the emissivity of the coating ranged from 0.55 to 0.92.

20899 (COO—2462-6) **Localized corrosion and stress corrosion cracking behavior of austenitic stainless steel weldments containing retained ferrite. Annual progress report, June 1, 1979-March 31, 1980.** Savage, W.F.; Duquette, D.J. (Rensselaer Polytechnic Inst., Troy, NY (USA). Dept. of Materials Engineering). Mar 1980. Contract AS02-76ER02462. 9p. Dep. NTIS, PC A02/MF A01.

Localized corrosion and stress corrosion cracking experiments were performed on single phase 304 stainless steel alloys and autogeneous weldments containing retained delta ferrite as a second phase. The results of the pitting experiments show that the presence of delta ferrite decreases localized corrosion resistance with pits initiating preferentially at delta ferrite-gamma austenite interphase boundaries. This increased susceptibility is reversible with elevated temperature heat treatments which revert the metastable ferrite phase to the equilibrium austenite phase. Experiments have also been conducted as functions of surface preparation, pH, Cl^- concentration and temperatures from 20°C to 290°C. These experiments indicate that pitting tendency for both single phase and two phase alloys is controlled by the physical properties of the passive films which are naturally forced. The results of the SCC experiments have shown that, for two phase alloys at temperatures from 20°C to 290°C, the ferrite phase also significantly affects stress corrosion resistance. At low temperatures and low pH the ferrite phase is preferentially dissolved, while at intermediate temperatures and pH's the δ/γ interface is the preferred crack path. At high temperatures cracking is associated with pitting, and depends sensitively on 0_2 concentration of the environment. Additionally, the addition of SO_4/sup =/ to chloride containing environments has a marked inhibitive effect on SCC.

20900 (LBL—10375) **Nuclear materials research progress reports for 1978.** Olander, D.R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1978. Contract W-7405-ENG-48. 109p. Dep. NTIS, PC A06/MF A01.

Research is presented concerning iodine stress corrosion cracking of Zircaloy, reduction of UO_2 and measurement of the oxygen-metal ratio, surface chemistry of epitaxial Si deposited by thermal cracking of Silane, kinetics of laser pulse vaporization of UO_2, retention and release of water vapor by UO_2, thermal gradient migration of metallic inclusions in UO_2, and molecular beam studies of H reduction of oxides. (FS)

20901 (PB—80-801863) **Air pollution effects on materials (citations from the NTIS data base). Report for 1964-October 1979.** Reed, W.E. (National Technical Information Service, Springfield, VA (USA)). Dec 1979. 160p. NTIS PC N01/MF N01.

The bibliography contains selected research reports on corrosion and damage by air pollution and includes studies on the effects upon steel, textiles, and building materials. Many studies cover a specific pollutant and its corrosive or damaging properties. (This updated bibliography contains 151 abstracts, 27 of which are new entries to the previous edition.)

20902 (PB—80-801871) **Air pollution effects on materials (citations from the American Petroleum Institute data base). Report for 1971-September 1979.** Reed, W.E. (National Technical Information Service, Springfield, VA (USA)). Dec 1979. 76p. NTIS PC N01/MF N01.

The bibliography contains selected research reports from worldwide literature on corrosion and damage by air pollution and includes studies on the effects upon steel, textiles, and building materials. Many studies cover a specific pollutant and its corrosive or damaging properties. (This updated bibliography contains 78 abstracts, 9 of which are new entries to the previous edition.)

20903 (SERI/TP—31-248(Vol.2)(Pt.2), pp 647-649) **Galvanic corrosion of Al alloys monitored by acoustic emission.** Mansfeld, F.; Stocker, P.J. (Rockwell International, Thousand Oaks, CA). Oct 1979.

From Reliability of materials for solar energy workshop; Denver, CO, USA (18 Dec 1978).

Rettig and Felsen have recently shown that acoustic emission has some promise in monitoring corrosion reactions of unstressed, freely corroding materials and galvanic couples. The data presented were typically taken over a 10 to 30 min period with emphasis on Al alloys. A program to evaluate the acoustic emission method in more detail, determine the source of the signal monitored, and obtain correlations between electrochemical and acoustic data is described.

20904 (SERI/TP—31-248(Vol.2)(Pt.2), pp 651-662) **Acoustic emission from corroding electrodes.** Mansfeld, F.; Stocker, P.J. (Rockwell International Science Center, Thousand Oaks, CA). Oct 1979.

From Reliability of materials for solar energy workshop; Denver, CO, USA (18 Dec 1978).

Acoustic emission measurements have been performed on unstressed Al alloys which were freely corroding or coupled to Cu, 4130 steel, Cd, or Zn in 3.5% NaCl. The rate of acoustic emission is in qualitative agreement with the observed corrosion rates. The acoustic emission is probably a result of hydrogen bubble evolution in the acidified pits. The rate of acoustic emission of 4130 steel in HCl also follows the corrosion behavior, decreasing significantly with addition of organic corrosion inhibitor. Stainless steel type 304 was studied freely corroding or at applied constant anodic or cathodic currents. The highest rates of acoustic emission were determined at cathodic currents; when an anodic current was applied the acoustic emission rate was higher than for a freely corroding sample and showed wide fluctuations which continued for some time when anodic polarization was discontinued. For localized corrosion of Al alloys and stainless steel the acoustic emission process seems to reflect the statistical nature of the pitting process.

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 20604, 20642, 20643, 21390

20905 (CONF-781194—5) **Effects of Si and Ti on the phase stability and swelling behavior of AISI 316 stainless steel.** Lee, E.H.; Rowcliffe, A.F.; Kenik, E.A. (Oak Ridge National Lab., TN (USA)). 1978. Contract W-7405-ENG-26. 28p. Dep. NTIS, PC A03/MF A01.

From Workshop on solute segregation and phase stability during irradiation; Gatlinburg, TN, USA (1 Nov 1978).

Swelling behavior of neutron irradiated stainless steels is influenced by solute segregation and preciptation phenomena. The extent to which in-reactor swelling behavior may be simulated by heavy ion irradiation depends upon the extent to which in-reactor phase changes are reproduced; this question is addressed by comparing the precipitation behavior under neutron irradiation with behavior during 4 MeV Ni ion irradiation for AISI 316 stainless steel and a related stainless steel containing additions of titanium and silicon. The results are discussed qualitatively in terms of the effects of damage rate on solute segregation and the effects of displacement cascades on the dissolution of particles. It is shown that the partitioning of elements into various phases during irradiation is not a sufficient condition for the initiation of swelling in stainless steels modified with silicon and titanium. It is also necessary for helium to be generated simultaneously with the breakdown of the matrix into various phases; it is believed that helium trapping at the growing particle-matrix interface is responsible for the observed physical association between voids and precipitates.

20906 (CONF-800607—28) **Irradiated Type 304 SS bend test ductility.** Garkisch, H.D. (Westinghouse Electric Corp., Madison, PA (USA). Advanced Reactors Div.). 1980. Contract AC15-76CL02395. 6p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society annual meeting; Las Vegas, NV, USA (8 Jun 1980).

A series of tests were performed to determine the available bending deformation capability and ductility of preirradiated Type 304 stainless steel (SS) for core applications. This material was tested under conditions at which it exhibits less ductility than Type 316 SS or other stainless steels currently under considerations for core applications. Tensile testing of Type 304 SS with specimens from EBR-II ducts which were irradiated to fluences between 5 to 10 x 10^{22} n/cm^2 (E > 0.1 MeV) revealed a significant reduction of uniform elongation (UE) and total elongation (TE), but smaller decreases in reduction of area (RA). These specimens fail with significant but very localized necking. The ductility of this material decreases with decreasing strain rate if the test temperature is above the irradia..on temperature. A large reduction in ductility is caused by a change from a transgranular to an intergranular fracture mode.

20907 (CONF-800609—1) **Mechanical and physical properties of irradiated type 348 stainless steel.** Beeston, J.M. (EG and G Idaho, Inc., Idaho Falls (USA)). 1980. Contract EY-76-C-07-1570. 45p. Dep. NTIS, PC A03/MF A01.

From 10. international symposium on effects of radiation on materials; Savannah, GA, USA (3 Jun 1980).

A type 348 stainless steel in-pile tube irradiated to a fluence of 3 x 10^{22} n/cm^2, E > 1 MeV (57 dpa), was destructively examined. The service had resulted in a maximum total creep of 1.8% at the high fluence. The metal temperature ranged between 623 and 652°K, hence the thermal creep portion of the total was negligible. Total creep was greater than had been anticipated from creep data for austenitic stainless steels irradiated in other reactors. The objectives of the destructive examination were to determine the service-induced changes of mechanical and physical properties, and to assess the possibility of adverse effects of both these changes and the greater total creep on the prospective service life of other tubes.

20908 (COO—2218-148) **Helium-induced blistering and volume swelling in nickel.** Fenske, G.R. (Illinois Univ., Urbana (USA)). 1979. Contract AS02-76ET52040. 165p. Dep. NTIS, PC A08/MF A01.

The results of an experimental investigation of He-induced blistering are presented. The mechanisms involved in blistering were examined by observing the microstructure of the implanted region using TEM. The volume swelling was measured as a function of the implant depth. The investigation revealed factors important in understanding the mechanisms involved in blister formation. First, a direct comparison of measured skin-thicknesses with the location of the maximum volume swelling demonstrated that the skin separates at the peak swelling depth, not at the end of the swelling profile. Second, an examination of the assumptions that have been used to predict skin-thicknesses revealed that the differences between predicted and measured skin thicknesses at low energies can be attributed to: failure to account for volume swelling in the skin, using a Gaussian approximation to the range profile, or one generated with a Monte-Carlo code, and uncertainties in the electronic stopping powers. Beyond a certain dose, the density of cavities in the peak-swelling region decreased with increasing dose; indicating that cavity coalescence does occur. A calculation of the He concentration required to fracture the load-bearing cross section between the cavities revealed that a sufficient quantity of He was available to generate the required gas pressures. These observations indicate that models based on coalescence followed by gas-driven deformation provide an accurate description of the mechanisms involved in blistering; and they can accurately predict skin thicknesses at low energies.

20909 (COO—4247-2) **Technical assessment of niobium alloys data base for fusion reactor applications.** Pionke, L.J.; Davis, J.W. (McDonnell Douglas Astronautics Co., St. Louis, MO (USA)). Aug 1979. Contract EG-77-C-02-4247. 90p. Dep. NTIS, PC A05/MF A01.

Refractory metals are one class of material to be developed in the Alloy Development For Irradiation Performance (ADIP) program recently initiated. A principal purpose of the assessment reported herein is to establish the existing data base for niobium alloys in order to help guide the work to be performed in the ADIP program. Major ADIP decisions include alloy selection/modification and irradiated/unirradiated material testing. This Assessment addressed the topics of: (1) niobium alloy development history and niobium metallurgy, (2) unirradiated mechanical properties, (3) irradiated properties, (4) corrosion, and (5) environmental effects.

20910 **Effects of radiation on structural materials: proceedings of the international symposium, 9th, 1978.** Sprague, J.A.; Kramer, O. (eds.). (US Nav Res Lab, Washington, DC). *Am. Soc. Test. Mater., Spec. Tech. Publ.;* No. 683, 1-684(1978).

From 9. international symposium on the effects of radiation on structural materials; Richland, Washington, USA (11 Jul 1978).

This symposium contains 42 papers, all of which are indexed separately. The papers cover the broad area of radiation damage of materials. They are divided into six subject areas: microstructure, fracture of thermal reactor materials, primary damage production and irradiation creep simulation, dosimetry and damage function analysis, mechanical properties, and creep.

20911 **Microstructural development during low-dose irradiation.** Hall, B.O.; Potter, D.I. (Argonne Natl Lab, Ill). *Am. Soc. Test. Mater., Spec. Tech. Publ.;* No. 683, 32-45(1978).

From 9. international symposium on the effects of radiation on structural materials; Richland, Washington, USA (11 Jul 1978).

Interstitial-impurity trapping has been included in a time-dependent nucleation and growth model that is used to calculate both vacancy and interstitial cluster densities and size distributions during irradiation. Calculations were performed for nickel alloys with interstitial-solute binding energies between 0 and 1 eV. Number densities of both types of cluster increased with increasing binding energy, with the interstitial cluster density more strongly affected. As binding energy increased, the time required for saturation of the interstitial cluster density increased. 33 refs.

20912 **Effects of bombarding ions on the void swelling profile in nickel.** Whitley, J.B.; Kulcinski, G.L.; Smith, H.V. Jr.; Wilkes, P. (Sandia Lab, Albuquerque, NM). *Am. Soc. Test. Mater., Spec. Tech. Publ.;* No. 683, 125-142(1978).

From 9. international symposium on the effects of radiation on structural materials; Richland, Washington, USA (11 Jul 1978).

Specimens of high-purity nickel were irradiated with high-energy carbon and aluminum ions to study the effect on the void microstructure of using different bombarding species. The depth-dependent damage structure was determined by preparing the foils such that they could be viewed directly in cross section. These results were then compared with previous irradiations performed on identical material using self-ions. The swelling behavior observed in the end-of-range region for all specimens was similar, implying that impurities introduced by the ion beam do not strongly influence the swelling response of the material. The mass of the irradiating ions had no noticeable effect on the swelling values achieved for similar damage states, even though the recoil energy spectra produced by the various ions were different. 23 refs.

20913 **Radiation-induced segregation in nickel-silicon alloys.** Rehn, L.E.; Okamoto, P.R.; Potter, D.I.; Wiedersich, H. (Argonne Natl Lab, Ill). *Am. Soc. Test. Mater., Spec. Tech. Publ.;* No. 683, 184-193(1978).

From 9. international symposium on the effects of radiation on structural materials; Richland, Washington, USA (11 Jul 1978).

Radiation-induced segregation was studied in a nickel 1 atomic percent silicon (Ni-1Si) alloy after irradiation at ~ 525°C with 3-MeV $^{58}Ni^+$ ions. Postirradiation profiles of alloy composition as a function of depth from the irradiated surface were obtained by standard Auger techniques and ion-sputtering at room temperature. Rapid segregation of silicon toward the irradiated surface was observed. The solubility limit of silicon in nickel was reached at the surface after a dose of only 0.05 displacements per atom (dpa). Segregation continued to increase up to the highest dose (6.5 dpa) investigated. Precipitation of Ni_3Si occurred at the external surface and internally on dislocation loops. 13 refs.

20914 Response of Inconel 600 to simulated fusion reactor irradiation. Wiffen, F.W. (Oak Ridge Natl Lab, Tenn). *Am. Soc. Test. Mater., Spec. Tech. Publ.;* No. 683, 88-106(1978).

From 9. international symposium on the effects of radiation on structural materials; Richland, Washington, USA (11 Jul 1978).

Inconel 600 was irradiated in the High Flux Isotope Reactor (HFIR) to provide a partial simulation of fusion reactor service. Specimens were irradiated at 55 to 700°C to investigate swelling and postirradiation tensile properties as a function of irradiation and test temperatures under conditions of concurrent displacement damage and helium production. Helium contents from 600 to 1800 atomic parts per million (appm) and displacement levels of 4 to 9 displacements per atom (dpa) were achieved, and the results are used to estimate performance in a fusion reactor environment. 13 refs.

20915 Effects of neutron irradiation on the microstructure of niobium and niobium-base alloys. Michel, D.J.; Smith, H.H. (Nav Res Lab Washington, DC). *Am. Soc. Test. Mater., Spec. Tech. Publ.;* No. 683, 107-124(1978).

From 9. international symposium on the effects of radiation on structural materials; Richland, Washington, USA (11 Jul 1978).

The microstructure and microhardness of niobium and commercial prototype niobium-base alloys have been investigated following fast neutron irradiation to a fluence of 1.1*10$sup 22$ neutrons (n)/cm$sup 2$ (<0.1 MeV), 4 displacements per atom (dpa), at 482$degree$C. The purpose of this work was to determine the effects of molybdenum and zirconium alloy additions on the resistance of niobium-base alloys to neutron irradiation. Neutron irradiation of the niobium and Nb-1Mo alloy produced very small voids whose mean diameters were in the range of 30 to 35 A. In all other alloys however, no voids were observed and the principal effect of the neutron irradiation was to form a high density of 30 to 40 A diameter dislocation loops which are believed to be primarily of interstitial character. The effect of fast neutron irradiation was to increase the microhardness of both niobium and all its alloys, with the largest increase in the Nb-1Zr alloy and the smallest increase in the ternary Nb-5Mo-1Zr alloy. 26 refs.

CERAMICS, CERMETS, AND REFRACTORIES

REFER ALSO TO CITATION(S) 19903, 20542, 20548, 20549, 20550, 20551, 20553, 20554, 20558, 20849

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 20115, 20140, 20547, 20552, 20708, 20758, 20761, 20762, 20921, 20935

20916 (CONF-790749—, pp 448-458) **Mechanical property improvement of protective coatings for turbine engines using coal-derived fuels.** Beale, H.A. (Battelle Columbus Labs., Columbus, OH); Wickersham, C.E.; Fairbanks, J.W. Dec 1979.

From Conference on advanced materials for alternate fuel capable directly fired heat engines; Castine, ME, USA (30 Jul 1979).

Material systems suitable for studying the effects of local strains around the dispersed phaser on the Peierls stress and mechanical properties of dispersion hardened coatings have been identified. Nb-NbB_2, Nb-NbC, Ti-TiB_2, and Ti-TiC coatings are currently being deposited by dual source electron beam evaporation. Experimental results from these investigations will be reported at a later date.

20917 (SAND—79-2375C) **Surface composition and erosion yields for CVD TiB_2 films subjected to low energy deuterium ion bombardment.** Nelson, G.C.; Borders, J.A. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 14p. (CONF-800455—4). Dep. NTIS, PC A02/MF A01.

From 4. international conference on plasma surface interactions in controlled fusion devices; Garmisch, F.R. Germany (21 Apr 1980).

The surface composition and low energy sputter yield of deuterium bombarded CVD TiB_2 films have been measured. The sputter yield increases with energy up to 1 keV where it reaches a maximum of 0.024 atoms/ion. Above 1 keV the yield decreases due to ion penetration effects. Surface composition measurements using Auger, x-ray photoelectron and secondary ion mass spectroscopies show that a surface layer about 200 A thick is depleted in B during 2 keV deuterium bombardment. This effect is attributed to preferential sputtering. Oxides and deuterides of titanium are also observed on the deuterium bombardment TiB_2 surface.

20918 Rate-controlling factors in the carbothermic preparation of UO_2-UC_2-C microspheres. Stinton, D.P.; Tiegs, S.M.; Lackey, W.J.; Lindemer, T.B. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *J. Am. Ceram. Soc.;* **61**: No. 11-12, 596-599(Nov 1979).

Rate-controlling factors in the conversion of UO_2 + C microspheres to UC_2 + C were investigated using a fluidized-bed furnace (13 cm in diam). Examination by x-ray diffraction, ion microprobe, and microstructural observation revealed that the conversion of UO_2 to UC_2 began at the surface of the microsphere and progressed toward the central unreacted core. Kinetic models for solid state reactions in spheres were evaluated by using quantitative mass spectrometric data on the rate of evolution of CO during conversion. This analysis revealed that the rate of conversion was controlled by reaction at the outer surface of the microsphere. Also, decreased partial pressures of CO accelerated the rate of reaction.

20919 SiC-fission product reactions in HTGR TRISO UC_2 and UC/sub x/O/sub y/ fissile fuel: I, kinetics of reactions in a thermal gradient. Smith, C.L. (General Atomic Co., San Diego, CA). Contract EY-76-C-03-0167. *J. Am. Ceram. Soc.;* **61**: No. 11-12, 600-606(Nov 1979).

The potential for SiC-lanthanide fission product reactions on the cool side of TRISO-coated UC_2 and $UC_{4.3}O_1$ fuel particles was studied in postirradiation thermal-gradient heating experiments. The kinetics of the reactions were obtained by determining the rate of decrease in SiC thickness as a function of temperature and fission density. Reaction rates are independent of the fission density for UC_2 kernel burnups >5% FIMA. The rate of change in SiC thickness for TRISO, UC_2 in a temperature gradient is $X\ (\mu m/h) = 4.2 \times 10^7 \exp(-3.283 \times 10^5/8.313T)$. No reduction in $O_{1.3}SiC$ thickness was observed in TRISO $UC_{4.3}$ fuel; the rates of SiC fission product reactions are at least an order of magnitude slower than those observed in UC_2. No metallic fission product release from TRISO particles was indicated until the SiC layer thickness was reduced by 50%.

20920 (PNL-TR—381) **Emitters for vacuum measurement coated with transition metal carbide films.** Hojo, H.; Nakayama, K. Translated from *Shinku;* **19**: No. 9, 312-317(1976). 22p. Dep. NTIS, PC A02/MF A01.

Cathodes formed by rf reactive sputtering of carbides of the transition metals Ti, Zr, Hf, Nb, and Ta on Ta surfaces were mounted on an ionization gage, and their properties were examined. It was established that the carbides have a high melting point, their work functions are low, and they are relatively stable chemically. Furthermore, the cathodes are simple to prepare, and cathodes prepared by this method also have few problems with respect to their heating and supporting methods. Cathodes with carbide films formed on Ta surfaces may be said to have numerous advantages for use as materials for hot cathodes to be used at low temperatures in ionization gages and residual gas analyzers. They also can be expected to be quite useful as materials for hot cathodes for use at a high brightness, such as in electron microscopes or devices applying electron beams.

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 20535, 20900, 20918, 20928

20921 (LBL—9274) **Microstructure development and interface studies in thick film conductor systems.** Nagesh, V.K. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1979. Contract W-7405-ENG-48. 147p. Dep. NTIS, PC A07/MF A01.

Thesis.

A new thick film conductor system which used acid treated (.01N HCl) lead borosilicate glass particles with chemically coated metal (silver) film was developed. Using only 40 wt% metal (silver), sheet resistivities as low as 45 milliohms/sq were obtained in this system. Detailed study of the microstructure development was done. Effect of the acid treatment of the glass particles prior to the metal coating was analyzed. X-ray photoelectron spectra studies showed preferential leaching of lead and boron from the surface of the glass. Good bonding between silver film and the glass was attributed to the oxidation of silver (to form Ag^+) in the presence of oxygen and H^+ ions on the glass surface (from acid treatment) and subsequent diffusion of Ag^+ into the glass to form a continuous chemical interface. A model to predict sheet resistivities of the new thick film conductors was developed.

20922 Microstructure and distribution of impurities in hot-pressed and sintered silicon nitrides. Krivanek, O.L.; Shaw, T.M.; Thomas, G. (Univ. of California, Berkeley). *J. Am. Ceram. Soc.;* **61**: No. 11-12, 585-590(Nov 1979).

Two hot-pressed (HS 130 and NC 132) and two sintered silicon nitrides (with MgO + Al_2O_3 and Y_2O_3 additives) were examined in detail by x-ray diffraction, emission spectroscopy, medium- and high-resolution electron microscopy, and x-ray microanalysis. The overall morphologies of the four materials are quite comparable. Very thin (10 to 20 A) intergranular glassy films were detected in all the materials at almost all grain and interphase boundaries. The composition of these glasses was determined by x-ray microanalysis using a 200-A electron probe and the softening temperature was estimated from available phase diagrams. The results are in good agreement with the known softening temperatures

for the four silicon nitrides, thereby confirming the central role played by glassy phases in determining the high-temperature mechanical properties of these materials.

20923 System CaO-P_2O_5-H_2O at 200°C. Feng, S.S.; Rockett, T.J. (Univ. of Rhode Island, Kingston). Contract BNL-418691-S. *J. Am. Ceram. Soc.;* **61**: No. 11-12, 619-620(Nov 1979).

The phase diagram was established for the ternary system CaO-P_2O_5-H_2O at 200°C and 1700 kPa. The solubility isotherm was determined by direct observation. Solid phases were analyzed by x-ray powder diffraction techniques and microscopy. Four solid phases were observed in equilibrium with liquid phases: portlandite, $Ca(OH)_2$, hydroxylapatite, $Ca_5(PO_4)_3OH$, monetite, $CaHPO_4$, and monocalcium orthophosphate monohydrate (MCPM), $Ca(H_2PO_4)_2.H_2O$.

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 19906, 20886

20924 Criterion for fracture-mirror boundary formation in ceramics. Shetty, D.K.; Bansal, G.K.; Rosenfield, A.R.; Duckworth, W.H. (Battelle Columbus Labs., OH). Contract W-7405-ENG-92. *J. Am. Ceram. Soc.;* **63**: No. 1-2, 106-108(Jan 1980).

Fracture-mirrors in brittle ceramics were studied. Mirror boundaries were predicted by an equation which solves the size and shape of the mirror. The physical implications of the mirror-boundary equation cannot be completely understood until the dynamic problem of a moving surface flaw is solved. (FS)

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 20140, 20708, 20714, 20761, 20900, 20919, 20920, 20931

20925 (DOE/ER/10453—01) **Properties of glasses with high water content. Progress report, June 15, 1979-February 29, 1980.** Tomozawa, M.; Watson, E.B. (Rensselaer Polytechnic Inst., Troy, NY (USA)). Mar 1980. Contract AC02-79ER10453. 12p. Dep. NTIS, PC A02/MF A01.

In this initial stage of the research on glasses with high water content, the hydrothermal units have been constructed and several water-bearing sodium silicate glasses have been prepared. Preliminary measurements were also made on thermal, mechanical, and electrical properties of these glasses. Several unique features have been revealed. For example, the electrical resistivity increases substantially with water content suggesting a possibility of preparing chemically durable glasses with large amounts of water.

20926 (UCRL—84247) **CO_2-laser polishing of fused silica surfaces for increased laser damage resistance at 1.06 μm.** Temple, P.A.; Milam, D.; Lowdermilk, W.H. (Naval Weapons Center, China Lake, CA (USA). Michelson Labs.; California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Apr 1980. Contract W-7405-ENG-48. 9p. (CONF-7910130—2). Dep. NTIS, PC A02/MF A01.

From Boulder damage conference; Boulder, CO, USA (Oct 1979).

Bare fused silica surfaces were prepared by subjecting the mechanically polished surface to a rastered cw CO_2 laser beam. Analysis shows that this processing causes: (a) removal of a uniform layer of fused silica; and (b) a probable re-fusing or healing of existing subsurface fractures. The fused silica removal rate is found to be a function of the laser intensity and scan rate. These surfaces are seen to have very low scatter and to be very smooth. In addition, they have exhibited entrance surface damage thresholds at 1.06 μm, and 1 nsec, which are substantially above those seen on the mechanically polished surface. When damage does occur, it tends to be at a few isolated points rather than the general uniform damage seen on the mechanicaly polished part. In addition to the damage results, we will discuss an observational technique used for viewing these surfaces which employs dark-field illumination.

20927 Energy levels of donor and acceptor dopants and electron and hole mobilities in α-Al_2O_3. Tiku, S.K.; Kroeger, F.A. (Univ. of Southern California, Los Angeles). *J. Am. Ceram. Soc.;* **63**: No. 1-2, 31-32(Jan 1980).

The relation between activation energy of conduction and the position of energy levels of donors and acceptors is discussed. Level positions of donor and acceptor dopants in Al_2O_3 at 1600°C are recalculated from published data. Carrier concentrations calculated from the new level positions lead to carrier mobilities with values scattering around 1 $cm^2V.s$, leaving the question of which conduction model is preferable unanswered. Relations of acceptor level positions with values of ionization potentials, redox potentials, and charge transfer bands are used to predict level positions for other transition metal acceptors.

20928 Iron diffusion in iron-aluminate spinels. Halloran, J.W.; Bowen, H.K. (Massachusetts Inst. of Technology, Cambridge). Contract E(49-18)-2215. *J. Am. Ceram. Soc.;* **63**: No. 1-2, 58-65(Jan 1980).

From 79. annual meeting of the American Ceramic society; Chicago, IL (26 Apr 1977).

The diffusion coefficient of ^{59}Fe in iron-aluminate spinels (Fe_3O_4-$FeAl_2O_4$) was measured by serial sectioning. The results were analyzed with a defect model, assuming that the predominant defects were cation vacancies and interstitials. At 1380°C, diffusion occurs in Fe_3O_4 and $Fe(Fe_{1.51}Al_{0.49})O_4$ by an interstitial mechanism at low P/sub O_2/ and a vacancy mechanism at high P/sub O_2/. Diffusion of iron is by the vacancy mechanism for higher hercynite concentrations, except that the results for the end-member, $FeAl_2O_4$, suggest an interstitial mechanism. At 10^{-6} atm O_2, and Arrhenius plot of D/sub Fe/ exhibits a minimum for Fe_3O_4 and $Fe(Fe_{1.51}Al_{0.49})O_4$. This effect is explained in terms of a mechanism change. The D/sub Fe/ is essentially independent of temperature in $Fe(Fe_{1.03}Al_{0.97})O_4$ and $Fe(Fe_{0.54}Al_{1.46})O_4$.

20929 Ion-probe measurement of oxygen self-diffusion in single-crystal Al_2O_3. Reed, D.J.; Wuensch, B.J. (Massachusetts Inst. of Technology, Cambridge). Contract EY-76-8-02-2923-A002. *J. Am. Ceram. Soc.;* **63**: No. 1-2, 88-92(Jan 1980).

From 79. annual meeting of the American Ceramic Society; Chicago, IL (26 Apr 1977).

Anion self-diffusion coefficients normal to (1 anti 102) were obtained for single-crystal Al_2O_3 in a 1.3 x 10^{-3} N/m^2 (10^{-5} torr) vacuum at 1585° to 1840°C. Tracer was supplied from an initial 650 to 1300 A $Al_2{}^{18}O_3$ layer produced by the oxidation of vapor-deposited Al metal films in an $^{18}O_2$ atmosphere at 520°C. Concentration gradients extended over depths of 3000 to 5000 A and were measured by mass spectrometry of material sputtered from the samples with a beam of Ar^+ ions. Crystals which had not been preannealed to remove surface damage displayed enhanced diffusion. Diffusion coefficients from preannealed crystals may be described by D/sub -0/ = 6.4 x 10^5 cm^2/s, with an activation energy of 188 +- 7 kcal/mol. The diffusion is interpreted as an extrinsic vacancy mechanism.

20930 Electrical conductivity of pure and Fe-doped magnesium-aluminum spinel. Weeks, R.A.; Sonder, E. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *J. Am. Ceram. Soc.;* **63**: No. 1-2, 92-95(Jan 1980).

The electrical conductivity of nominally pure and Fe-doped $MgAl_2O_4$ spinel was measured at 700 to 2000°K. The results for pure stoichiometric spinel can be fitted by exponential expressions with different activation-energy parameters in three ranges of temperature. The conductivity of a sample containing 0.1% iron is the same as that of pure samples when the iron is in the Fe^{2+} form; it increases approximately a factor of two when the ion is in the Fe^{3+} form. The results are consistent with ionic conduction due to motion of cation vacancies.

CORROSION AND EROSION

REFER ALSO TO CITATION(S) 19906, 20535, 20537, 20555, 20609, 20761, 20917

20931 Vaporization of silica in steam atmosphere. Cheng, M.C.; Cutler, I.B. (Univ. of Utah, Salt Lake City). *J. Am. Ceram. Soc.;* **61**: No. 11-12, 593-596(Nov 1979).

The effect of temperature and steam pressure on the vaporization and corrosion of silica was studied by measuring weight loss as a function of time. The reaction rate increased exponentially with temperatures up to 1200°, with a maximum rate of reaction at ≃ 1350°C. Above this temperature the rate abruptly decreased with increasing temperature. The pressure dependence of the reaction was approximately linear. The activation energy was ≃ 25 kcal/mol for the reaction at 0.84 and 14.5 atm steam.

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 20604, 20917

20932 (SAND—80-0554C) **Miners-Iron test of optical fibers.** HEckman, R.C.; Allen, J.W.; Dolce, S.R.; Hohlfelder, J.J.; Machin, E.D. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 5p. (CONF-800307—6). Dep. NTIS, PC A02/MF A01.

From Fiber optic in the nuclear environment symposium; Adelphi, MD, USA (25 Mar 1980).

An experiment is described in which a number of optical fibers will be exposed to nuclear radiation in the Miners-Iron event at the Nevada Test Site. Two polymer clad silicon fibers and a borosilicate clad fiber will experience a dose of several Mrads, while a second set will experience about 0.1 Mrad. Attenuation and luninescence experiments are planned. Optic fibers will also be used for cables. (FS)

20933 SiC-fission product reactions in HTGR TRISO UC_2 and UC/sub x/O/sub y/ fissile fuel: II, reactions under isothermal conditions. Smith, C.L. (General Atomic Co., San Diego, CA). Contract EY-76-C-03-0167. *J. Am. Ceram. Soc.;* **61**: No. 11-12, 607-613(Nov 1979).

The performance of irradiated TRISO UC_2 and TRISO $UC_{1.9}O_{1.9}$ HTGR fissile fuel particles was studied by postirradiation isothermal heating at 1600 to 2000°C to evaluate HTGR fuel performance models. Test conditions were similar to reactor conditions predicted for hypothetical core heatup events evaluated during safety and licensing studies. Less than 2% of the particles experienced failure of all coating layers with rapid gaseous and metallic fission product release (pressure vessel failure). Lanthanide fission product, Cs-137, and Kr-85 release occurred in the remaining particles by diffusion through intact outer pyrocarbon layers after Si-Clanthanide fission product reactions had penetrated the SiC layers. The rates of SiC-fission product reactions depended on the fission density of the test samples and were less than or equal to those observed in a thermal gradient. Test results showed the HTGR fuel performance models to be very conservative.

COMPOSITE MATERIALS

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 20518

20934 (CONF-800457—1) **Synthesis and electronic applications of oxide-metal eutectic composites.** Holder, J.D.; Cochran, J.K.; Hill, D.N.; Chapman, A.T.; Clark, G.W. (Oak Ridge National Lab., TN (USA); Georgia Inst. of Tech., Atlanta (USA)). 1980. Contract W-7405-ENG-26. 34p. Dep. NTIS, PC A03/MF A01.

From Verbunderkstoffe 1980; Kontanz, F.R. Germany (17 Apr 1980).

A review is given of important developments in the synthesis of oxide-metal eutectic composites and the composite application in the continuing development of field emitters. Known metal oxide-metal binary and ternary eutectic systems are listed. The synthesis, electrical conductivity, thermodynamics, and applications are discussed. (FS)

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 20518

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 20934

CORROSION, EROSION, AND DEGRADATION

REFER ALSO TO CITATION(S) 21004

POLYMERS AND PLASTICS

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 20281, 20695, 20938

20935 Neutron absorbing room temperature vulcanizable silicone rubber compositions. Zoch, H.L. US Patent 4,176,093. 27 Nov 1979. Filed date 22 Feb 1977. 16p.

PAT-APPL-770,331.

A neutron absorbing composition is described and consists of a one-component room temperature vulcanizable silicone rubber composition or a two-component room temperature vulcanizable silicone rubber composition in which the composition contains from 25 to 300 parts by weight based on the base silanol or vinyl containing diorganopolysiloxane polymer of a boron compound or boron powder as the neutron absorbing ingredient. An especially useful boron compound in this application is boron carbide. 20 claims.

STRUCTURE AND PHASE STUDIES

20936 (COO—2754-5) **Structure of glasses containing transition metal ions. Progress report, February 1, 1979-January 31, 1980.** White, W.B.; Furukawa, T.; Tsong, I.S.T.; Fox, K.; Herman, J.S.; Houser, C.; Nelson, C. (Pennsylvania State Univ., University Park (USA). Materials Research Labs.). Feb 1980. Contract EY-76-S-02-2754. 29p. Dep. NTIS, PC A03/MF A01.

New normal coordinate calculations were used to relate the vibrational frequencies of silicate glasses to Si-O force constants. These appear to account for the observed frequency shifts with degree of silica polymerization. Raman spectroscopy has been used to elucidate the structure of sodium borosilicate glasses and of sodium aluminosilicate glasses. Structures of compositionally complex glasses can be understood if spectra are measured on many glasses spaced at small compositional intervals. Optical absorption spectra were used to investigate the structural setting of iron in alkali silicate glasses. Research on the alkali-hydrogen exchange in alkali silicate glasses was completed and additional work on ternary glasses is under way. A series of appendices present completed work on the structural investigations of alkali borosilicate glasses, on the structural setting of transition metal ions in glasses, and on the diffusion of hydrogen in alkali silicate glasses.

20937 (DOE/ER/10421—1) **Effect of processing conditions on the reliability of cross-linked polyethylene cable insulation. First year report.** Phillips, P.J. (Utah Univ., Salt Lake City (USA). Div. of Materials Science and Engineering). [nd]. Contract AC02-79ER10421. 17p. Dep. NTIS, PC A02/MF A01.

Progress is reported in crystallization and morphology, treed cables, and cable production on the reliability of cross-linked polyethylene cable insulation. Scanning electron microscopy of polished surfaces etched with carbon tetrachloride vapor, differential scanning calorimetry and x-ray diffraction were used for morphological investigations until recently when good results have been obtained using the technique of permanganic acid etching. (FS)

MECHANICAL PROPERTIES

20938 (UCRL—84208) **Structure and property relationships of poly (p-phenylene terephthalamide) fibers.** Morgan, R.J.; Mones, E.T.; Steele, W.J.; Deutscher, S.B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Apr 1980. Contract W-7405-ENG-48. 4p. Dep. NTIS, PC A02/MF A01.

To conserve energy, high performance, fiber-epoxy composites are increasingly used by the transportation industry as lightweight, strong, structural materials. In the past either graphite, glass, or boron fibers predominantly were used in these composites. However, the incorporation of high-modulus poly (P-phenylene terephthalamide) (PPTA) fibers (Kevlar 49$^+$, E.I. du Pont) in these composites can increase the energy needed to fracture them, because they exhibit larger ultimate elongations ($\sim$ 3 to 4%) relative to boron or graphite fibers ($<\sim$ 1%). The mechanical performance of PPTA fibers used over long periods in high performance composites must be known. To predict the durability of the fibers and their composites with confidence, we must understand the relations between the chemical and physical structure, the deformation and failure modes and mechanical response, and how such relations are modified by fabrication and the environment. We will review our understanding of PPTA fibers and discuss the areas we are investigating.

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 20932

OTHER MATERIALS

PREPARATION AND MANUFACTURE

REFER ALSO TO CITATION(S) 20278, 20279, 20282, 20283, 20290, 20291, 20296, 20299, 20301, 20302, 20303, 20304, 20305, 20308, 20311

20939 (PB—80-106669) **Feasibility investigations of growing and characterizing gallium arsenide crystals in ribbon form. Final report.** Berkowitz, J.B. (Little (Arthur D.), Inc., Cambridge, MA (USA)). 4 Jan 1978. 54p. NTIS, PC A04/MF A01.

This report presents the results of a program to investigate the feasibility of growing gallium arsenide crystals in ribbon form. Crystals of GaAs, .05 mm thick and 10 mm long were propagated using a confined zone melting apparatus. To prevent loss of arsenic, a modification using boron oxide as a sealant was used successfully. Attempts at growing thin sheets of GaAs on single crystal sodium chloride substrates, via liquid phase epitaxy, were not successful; however, a combined VPE/LPE technique may hold some promise.

STRUCTURE AND PHASE STUDIES

20940 (CONF-800205—8) **Characterization of near surface regions in irradiated Ni(Si) alloys.** Rehn, L.E.; Averback, R.S.; Okamoto, P.R. (Argonne National Lab., IL (USA)). 1980. Contract W-31-109-ENG-38. 17p. Dep. NTIS, PC A02/MF A01.

From American Institute of Metallurgical Engineers meeting; Las Vegas, NV, USA (Feb 1980).

Transmission electron microscopy (TEM), Rutherford backscattering spectrometry (RBS), Auger electron spectroscopy (AES), and infra-red pyrometry (IRP) have been used to characterize the

growth of Ni_3Si films on the surfaces of irradiated Ni(Si) alloys. Results from each of the four techniques are presented and discussed, and comparisons are made between the different techniques. AES measurements are reported which suggest that Si concentrations significantly in excess of that found for stoichiometric Ni_3Si are induced in regions very near to the surface during irradiation.

20941 Tentative SrF_2-LaF_3 phase diagram. Holcombe, C.E. (Union Carbide Corp., Oak Ridge, TN). Contract W-7405-ENG-26. *J. Am. Ceram. Soc.*; 63: No. 1-2, 112(Jan 1980).

The system SrF_2-LaF_3 was studied because of the reported high solubility of LaF_3 in SrF_2 and the indicated thermal maximum of the liquidus curve. A tentative phase diagram was made. The SrF_2 and LaF_3 end members melted within 5°K of the reported values. Compositions at 25 or 33 mol% LaF_3 melt at 1835°K, 70°K higher than LaF_3 and 95° higher than SrF_2. (FS)

PROPERTIES

REFER ALSO TO CITATION(S) 20886, 21391, 21452

CORROSION, EROSION, AND DEGRADATION

REFER ALSO TO CITATION(S) 20901, 20902

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 20940

CHEMISTRY

REFER ALSO TO CITATION(S) 20194

20942 (LBL—10308) **Coordination chemistry of metal surfaces and metal complexes.** Muetterties, E.L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1979. Contract W-7405-ENG-48. 17p. (CONF-800615—1). Dep. NTIS, PC A02/MF A01.

From 7. international congress on catalysis; Tokyo, Japan (30 Jun 1980).

The coordination chemistry of two isomeric molecules, acetonitrile and methyl isocyanide, has been characterized for (A) single crystal nickel surfaces as a function of crystallography and surface composition, (B) nickel catalyst surfaces and (C) molecular mononuclear and polynuclear metal complexes. Conditions have been established for the catalytic isomerization of methyl isocyanide to acetonitrile within these nickel surface and molecular complex regimes. A comparison is made of the acetonitrile and methyl isocyanide chemistry between the surface and molecular complex areas.

20943 (SAND—80-8003) **CHEMKIN: a general-purpose, problem-independent, transportable, FORTRAN chemical kinetics code package.** Kee, R.J.; Miller, J.A.; Jefferson, T.H. (Sandia Labs., Livermore, CA (USA)). Mar 1980. Contract EY-76-C-04-0789. 203p. Dep. NTIS, PC E$12.50/MF E$3.50.

The CHEMKIN package is comprised of two major components -- the INTERPRETER and the gas-phase subroutine library. The INTERPRETER is a FORTRAN code which is used to read a symbolic description of an arbitrary, user-specific chemical reaction mechanism. The output of the INTERPRETER is a data file which forms a link to the gas-phase subroutine library. This library is a collection of about 200 modular FORTRAN subroutines which may be called to return thermodynamic properties, chemical production rates, derivatives of thermodynamic properties, derivatives of chemical production rates, or sensitivity parameters. Thermodynamic properties for the chemical species are given in terms of polynomial fits to the specific heats, and are stored on a thermodynamic data base. The data base is in exactly the same format as the one used in the NASA chemical equilibrium code. Therefore, the user may either supply his own data base or use the NASA data base directly.

ANALYTICAL AND SEPARATIONS CHEMISTRY

ACTIVATION AND NUCLEAR REACTION PROCEDURES

REFER ALSO TO CITATION(S) 20100, 20163, 21371, 21540

20944 (CONF-800433—1) **Nuclear methods in coal research.** Lyon, W.S. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 9p. Dep. NTIS, PC A02/MF A01.

From 4. international conference on nuclear methods in environment and energy research; Columbia, MO, USA (14 Apr 1980).

Nuclear methods, particularly neutron activation analysis (NAA) provide useful information about elemental constituents in coal and fly ash, but often other techniques are required to supplement NAA data. Spark source mass spectrometry and atomic absorption have been studied as methods for determination of certain elements in coal that are not easily measured by NAA. In work concerned with the chemical speciation of elements in fly ash, a number of analytical techniques have been used; these include NAA, chemical etching and separation, optical and electron microscopy and x-ray diffraction.

CHEMICAL PROCEDURES

REFER ALSO TO CITATION(S) 19982, 20050

RADIOMETRIC AND RADIOCHEMICAL PROCEDURES

REFER ALSO TO CITATION(S) 20100, 20118, 21215

20945 (ANL—78-65(Pt.3), pp 62-63) **Ion exchange separation and radiochemical determination of uranium.** Orlandini, K.A. 1978.

In Radiological and Environmental Research Division: ecology. Annual report, January-December 1978.

A previously reported method developed for the determination of uranium at the submicrogram level by alpha spectrometric-isotopic dilution in soil, sediment, water, and biota. The uranium is separated from most of the other elements by making the solution 0.4 M in nitric acid and 1.6 M in aluminum nitrate and passing it through a column containing a strongly basic anion exchange resin. The uranium is electroplated onto stainless steel and assayed alpha spectrometrically. Sample preparation and techniques for handling interfering elements are discussed. (JGB)

20946 (CONF-791049—25) **Development of resin-bead isotope-dilution mass spectrometric techniques for Tc-99 analysis.** Walker, R.L. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 11p. Dep. NTIS, PC A02/MF A01.

From 23. conference on analytical chemistry in energy technology; Gatlinburg, TN, USA (9 Oct 1979).

An isotope dilution mass spectrometric method was developed for the analysis of Tc-99 after isolating it onto anion exchange resin beads. A single resin bead containing Tc-99 and Tc-97 spike is loaded onto a rhenium V-shaped filament for thermal emission mass spectrometry. The application of this technique requires the use of a mass spectrometer of high abundance sensitivity and pulse counting capability for the necessary ion detection sensitivity. This paper discusses the development of the technique, including the mass spectrometer, choice of filament material, scanning modes, interferences, and present achievable sample sensitivities.

20947 (LA-UR—80-743) **Effects of (α,n) contaminants and sample multiplication on statistical neutron correlation measurements.** Dowdy, E.J.; Hansen, G.E.; Robba, A.A.; Pratt, J.C. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 6p. (CONF-800315—13). Dep. NTIS, PC A02/MF A01.

From 2. symposium of the European Safeguards Research and Development Association; Edinburgh, UK (26 Mar 1980).

The complete formalism for the use of statistical neutron fluctuation measurements for the nondestructive assay of fissionable materials has been developed. This formalism includes the effect of detector deadtime, neutron multiplicity, random neutron pulse contributions from (α,n) contaminants in the sample, and the sample multiplication of both fission-related and background neutrons.

20948 (PB—298149) **Acid dissolution method for the analysis of plutonium in soil: evaluation of an interlaboratory collaborative test and comparison with results of a fusion method test. Final report, 1 February 1976-1 June 1978.** Whittaker, E.L.; Grothaus, G.E. (Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab.). Mar 1979. 69p. NTIS PC A04/MF A01.

The data from an interlaboratory collaborative test are presented. A statistical analysis of the data is also presented. From that analysis, statements are made of the combined within-laboratory precision, the systematic error between laboratories, the total error between laboratories based on a single analysis, and the method bias. Soil samples used for the test contained plutonium in a highly refractory form, a very insoluble form, and therefore, difficult to measure the true concentration. Plutonium concentrations in those samples ranged from 0.1 to 10 dpm/g of soil. A comparison is made between the acid dissolution method and a fluoride-pyrosulfate fusion method which was tested in a similar study using the same test samples.

SPECTRAL PROCEDURES

REFER ALSO TO CITATION(S) 19994, 20095, 20100, 20203, 20217, 20979, 21157, 21208

20949 (LA-tr—80-6) **Determination of the uranium content of phosphate rocks: extractions and spectrophotometric determination by Arsenazo in organic solvent.** Levin, R.; Ronen, S. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). Mar 1980. Translation of NRCN—433, March 1977. 17p. Dep. NTIS, PC A02/MF A01.

A method is described for the spectrophotometric determination of uranium (VI) in the presence of various elements by extraction with 0.1 M trioctylphosphine oxide (TOPO) dissolved in cyclohexane from 1.5 M nitric acid. The color is developed directly in the organic phase using Arsenazo I. The optical absorbance is measured at a wavelength of 600 nm. Possible interferences of accompanying elements can be eliminated by reduction with ascorbic acid and by screening with sodium fluoride. This method allows the determination of any uranium content, in the 20 to 200 μg range, of phosphate rocks containing up to 1 g $(PO_4)^{3-}$.

20950 (PNL-TR—375) **Efficient matrix correction in x-ray fluorescence spectrometry.** Plesch, R.; Thiele, B. Translated from *Anal. Chim. Acta;* **112**: 75-82(1979). 18p. Dep. NTIS, PC A02/MF A01.

The SPECTRA 310 program for matrix correction in x-ray fluorescence spectrometry allows concentrations as well as intensities of the matrix elements to be included in the correction factors. Alongside an existing testing system, this allows the efficiency of the correction method to be estimated and the quality of standards to be assessed. A program for trace analysis improves general analysis in the trace range, and a test program allows conclusions to be made about the statistical precision of the analytical equipment used.

20951 (LA-tr—79-17) **Colorimetric analysis of silicic acid in the presence of fluorine ion.** Taruya, T. Translated from *Nippon Kagaku Zasshi;* **77**: 1292-1295(1956). 11p. Dep. NTIS, PC A02/MF A01.

Results can be summarized as follows: (1) the presence of fluoride suppresses the color development of silicomolybdic acid; (2) the masking capacity and masking character of boric acid, beryllium and aluminum for fluoride were compared and the masking power declines in the order of aluminum, beryllium, and boric acid; (3) when boric acid is used as the masking agent, the F/H_3BO_3 ratio must be less than 1/8; (4) fluoride is completely masked by aluminum at F:Al = 1:2; and (5) the amount of time required for silicomolybdic acid to develop maximum color depends significantly on the fluoride concentration, the quantity of a masking agent added, the acid concentration and the temperature. Whenever a masking agent is used, the colorimetric analysis cannot simply be conducted at a certain time after adding the masking agent; rather, the maximum color development of silicomolybdic acid must be confirmed before colorimetric analysis.

SEPARATION PROCEDURES

REFER ALSO TO CITATION(S) 21208

20952 (DOE/ER/10489—1) **Investigation of the solution properties of the transuranium elements. Progress report, July 1, 1979-June 30, 1980.** Ensor, D.D. (Tennessee Technological Univ., Cookeville (USA)). 1980. Contract AS05-79ER10489. 13p. Dep. NTIS, PC A02/MF A01.

A linear polyether, 1,13-Bis-[8-quinolyl]-1,4,7,10,13-pentaoxatridecane, was investigated as a possible extraction agent for the trivalent actinides. The normally lipophilic substance was found to protonate when contacted with aqueous phases of high hydrogen ion concentration. Several commercially available cryptands, 222BB and 222D, were also studied as possible extraction agents. The protonation reactions of these compounds lead to their almost complete extraction into the aqueous phase at pH < 2. The characteristics of these compounds are similar to the tertiary amine extraction agents now well-characterized and thus the macrocyclic compounds hold further promise as extraction agents.

20953 (LBL—10480) **Solvent extraction of phenols from water.** Greminger, D.C.; Burns, G.P.; Lynn, S.; Hanson, D.H.; King, C.J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Feb 1980. Contract W-7405-ENG-48. 16p. (CONF-800610—1). Dep. NTIS, PC A02/MF A01.

From American Institute of Chemical Engineering conference; Philadelphia, PA, USA (8 Jun 1980).

Methyl isobutyl ketone (MIBK) and diisopropyl ether (DIPE) have been evaluated as solvents for extraction of phenols, at high dilution, from water. Equilibrium distribution coefficients (K/sub D/) have been measured for phenol, dihydroxybenzenes and trihydroxybenzenes in both solvents as a function of pH. Particularly for the multihydric phenols, MIBK gives substantially higher values of K/sub D/ than does DIPE. The effect of pH can be described quantitatively through a simple ionization model, using published values of dissociation constants for the various phenols. Some method for removal of residual dissolved solvent must ordinarily be included in any extraction process for phenols. Possibilities include atmospheric-steam or inert-gas stripping, vacuum-steam stripping, and extraction with a second solvent. Vacuum-steam stripping is a particularly attractive choice for removal of MIBK; this reinforces the utility of MIBK as a solvent. The optimal temperature for vacuum stripping is generally the temperature of the extraction operation, which in turn is related to the effect of temperature on K/sub D/. Values of K/sub D/ for phenol-water-MIBK were determined at 30, 50, and 75°C, and were found to decrease with increasing temperature at all concentrations.

20954 (PNL-SA—7500) **Role of tissue analysis for petroleum hydrocarbons in marine pollution research.** Blaylock, J.W.; Vanderhorst, J.R.; Anderson, J.W. (Battelle Pacific Northwest Labs., Richland, WA (USA)). May 1979. Contract EY-76-C-06-1830. 15p. (CONF-7905146—1). Dep. NTIS, PC A02/MF A01.

From Marine chemistry symposium; Victoria, Canada (31 May 1979).

Analytical chemists have devoted considerable effort to develop detailed analysis of hydrocarbons in tissues. The methods developed are time consuming, and there is often a high degree of variability between samples. In light of this, the cost effectiveness of these analyses is questioned. The need to simplify tissue analysis is discussed. Data are provided on a number of benthic marine organisms exposed to continuous contamination with crude oil and problems of individual organism variability are discussed.

INORGANIC AND PHYSICAL CHEMISTRY

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 20233

20955 (AD-A—072710) **Adsorption of oxygen on Pt (111) and its reactivity to hydrogen and carbon monoxide. Interim report.** Monroe, D.R.; Merrill, R.P. (California Univ., Berkeley (USA)). Oct 1978. 23p. NTIS, PC A02/MF A01.

Oxygen was found to adsorb on Pt(111) with an initial sticking coefficient of 0.048 + or - .006 and linear adsorption kinetics. The surface saturated at an oxygen to platinum ratio of 1:4. The reactivity of adsorbed oxygen to hydrogen and CO was determined from steady state oxygen coverages for H2-O2 and CO-O2 mixtures. From the reactivity data which show reaction probabilities of 1.0 for CO and 1/2 for H2 over a wide range of oxygen coverages, it is concluded that both H2 and CO are reactive in mobile states which are probably the precursors to adsorption.

20956 (AD-A—075218) **Organosubstituted phosphazenes. XII. He(I) photoelectron spectra of selected phenyl- and p-N,N-dimethylaminophenylfluorocyclotriphosphazenes. Technical report.** Allen, C.W.; Green, J.C. (Vermont Univ., Burlington (USA). Dept. of Chemistry). 1 Oct 1979. Contract N00014-77-C-0605. 23p. NTIS, PC A02/MF A01.

He(I) photoelectron Spectra are presented for P3N3F6-n (C6H5) (n=1,2,4) and P3N3F5C6H4N(CH3)2. Ionization energies are discussed in terms of perturbations of molecular orbitals of the parent aryl and phosphazene functions. The data confirm the strong electron withdrawing effect of the P3N3F5 moiety and show a dramatic decrease in this effect as fluorine atoms are replaced by phenyl groups. One also observes a significant destabilization of the phosphazene out of plane pi molecular orbital as the fluorine atoms are replaced by phenyl groups. The ionizations from the phenyl pi a2 and pi b1 orbitals are unresolved in phenyl phosphazenes thus demonstrating the lack of significant phosphazene - aryl mesomeric interactions. The electronic effect of the electron donating dimethylamino substituent on the phenyl unit is transmitted to the phosphazene through the sigma bond system.

20957 (AD-A—075264) **Synthesis of tetranuclear mixed-metal clusters via the reaction of $Co(CO)_4$- with closed metal carbonyl trimers. Crystal and molecular structure of (Ph3P)2nCoRu3(CO)13. Interim technical report.** Steinhardt, P.C.; Gladfelter, W.L.; Harley, A.D.; Fox, J.R.; Geoffroy, G.L. (Pennsylvania State Univ., University Park (USA). Dept. of Chemistry). 3 Oct 1979. Contract N00014-77-C-0417. 40p. NTIS, PC A03/MF A01.

The new clusters HCoRu3 (CO)13, HCoRu2Os(CO)13, HCoRuOs2(CO)13, and HCoOs3(CO)13 have been synthesized by allowing K(Co(CO)4) to react with Ru3(CO)12, Ru2Os(CO)12, RuOs2(CO)12, and Os3(CO)12, respectively, followed by protonation. Reaction of KCo(CO)4 with Fe3(CO)12, Fe2Ru(CO)12, and FeRu2(CO)12 followed by acidification did not lead to the desired hydrido mixed-metal clusters but instead to various other products. Reaction of (PPN) (Co(CO)4) (PPN= (Ph3P)2N) with Fe3(CO)12 and Ru3(CO)12 without subsequent acidification gave the salts (PPN) (CoFe3(CO)13) and (PPN) (CoRu3(CO)13). The latter was structurally characterized by single crystal X-ray. It crystallizes in the space group P1 with Z= 2 and unit cell dimensions a = 9.783(5) Angstrons, b = 14.768(5) Angstrons, c = 18.675(5) Angstons, Alpha = 110.39(3) deg, Beta = 99.02(4) deg, Gamma = 91.44(4) deg, and

V = 2489(4) Angstrons 3. Diffraction data (0 deg < 20 < 50 deg) were collectedwith an Enraf-Nonius CAD4 automated diffractometer, using graphite-monochromat ized MoK Alpha radiation, and the structure was refined to R = 0.036 and RW = 0.044 for 6150 independent reflections with I greater than or equal to 3.0 sigma (I). The molecule contains a tetrahedral CoRu3 core with each Ru atom bonded to three terminal carbonyls, the Co atom bonded to one terminal carbonyl, and with a carbonyl ligand bridging each of the three Co-Ru bonds. Analogous reactions of (PPN) (Co(CO)4) with Fe2Ru(CO)12 and FeRu2(CO)12 gave products formulated as (PPN) (CoFe2Ru(CO)13) and (PPN) (CoFeRu2(CO)13) but these salts were not obtained pure.

20958 (COO—2807-19) **Experimental investigation of the chemistry of excited states of rare gases. Final report, October 15, 1978-October 14, 1979.** Setser, D.W. (Kansas State Univ., Manhattan (USA). Dept. of Chemistry). Feb 1980. Contract EY-76-S-02-2807. 11p. Dep. NTIS, PC A02/MF A01.

The status of photosensitized studies of reactions of $Xe(^3P_2)$ and $Kr(^3P_1)$ with fluorine, chlorine, bromine, and iodine donors is reported. Results for KrCl and KrF are summarized.

20959 (COO—4254-3) **Properties of supported metal catalysts. Progress report, 1 April 1979-1 April 1980.** Burwell, R.L. Jr.; Butt, J.B.; Cohen, J.B. (Northwestern Univ., Evanston, IL (USA)). Mar 1980. Contract EG-77-S-02-4254. 19p. Dep. NTIS, PC A02/MF A01.

Some eleven Pd/SiO_2 catalysts have been prepared by ion exchange or impregnation, with percent exposed varying from 7.3 to 82.8. Stored catalyst is more difficult to reduce than clean catalyst with short-time exposure to oxygen. Oxidation is less complete as percent exposed decreases. Upon cooling in H_2 from 450°C and flushing with argon, there is more H than in a catalyst exposed to H_2 at 25°C and then flushed. The Pd pa ticles are more elongated than the Pt catalysts we have studied, and the particles are less perfect. The activity and selectivity of the entire series were examined with the hydrogenolysis of methylcyclopropane at 0°C. These catalysts are mildly structure sensitive. Formation of palladium hydride during pretreatment (observed with in-situ x-ray diffraction studies) reduces the activity, but this occurs primarily for the low dispersions. Purging in O_2 He or Ar for 15 to 30 min at 20°C eliminates the hydride. The turnover frequency for i-butane formation is ten times higher for Pt/SiO_2 than for these Pd/SiO_2 catalysts, but the n-butane activity is similar for both; as a result the selectivity of Pd/SiO_2 is one sixth that for the Pt/SiO_2 catalysts. The reduction in loading with increasing temperature of H_2 reduction of Pt/SiO_2 was confirmed with additional x-ray measurements and by desorption studies. This effect is largest for the lowest % exposed and is accompanied by a decrease in particle size and a shift of the size distribution to smaller sizes.

20960 (DOE/ER/04216—6) **Synthesis, chemistry and catalytic activity of complexes of lanthanide and actinide metals in unusual oxidation states and coordination environments. Progress report, February 1, 1979-January 31, 1980.** Evans, W.J. (Chicago Univ., IL (USA). Dept. of Chemistry). Oct 1979. Contract AC02-77ER04216. 12p. Dep. NTIS, PC A02/MF A01.

The new synthetic and catalytic reactions involving lanthanide metals which were discovered in the first years of this project have been examined in more detail in the past year. Synthetic and catalytic model systems have been theoretically developed and experimental testing of these hypotheses is in progress. New techniques are being applied to the lanthanide metals to further elucidate the chemistry of these complexes.

20961 (ISM—252) **Modeling the chemical equilibria in solid liquid reactions: application to leaching of ores.** Liddell, K.C.; Bautista, R.G. (Ames Lab., IA (USA); Iowa State Univ. of Science and Technology, Ames (USA). Dept. of Chemical Engineering; Montana State Univ., Bozeman (USA). Dept. of Chemical Engineering). 1979. Contract W-7405-ENG-82. 24p. (CONF-791063—3). Dep. NTIS, PC A02/MF A01.

From Conference on thermodynamics of aqueous systems with industrial applications; Washington, DC, USA (22 Oct 1979).

In many solid-liquid systems of practical interest, the heterogeneous reactions do not reach equilibrium. Reactions among dissolved species, however, generally are faster. Hence it is often possible to regard the heterogeneous reactions in such a system as producing changes in the concentrations of some of the liquid phase species, thereby causing the equilibria in the solution to shift. Clasifying the reactions in such a system as reversible or irreversible makes possible the development of a mathematical model of the changes in solution concentration accompanying a heterogeneous process. The derivation and use of the model equations are discussed. The information that would be needed to calculate concentrations in an equilibrium liquid phase system must be supplemented by kinetic information in order to make the heterogeneous problem determinate. The information needed includes: (1) the stoichiometry of each reaction, reversible or irreversible, taking place; (2) analytical concentrations in the solution phase at the start of the heterogeneous reactions; (3) equilibrium constants for the reversible reactions, which may be either true thermodynamic or apparent constants; and (4) kinetic data in the heterogeneous reactions. A set of equations is obtained that includes a linear equation for each reversible liquid phase reaction, material balances and, in the case of an aqueous liquid phase, a charge balance; following a change of variable, kinetic equations complete the set. The equations are algebraic in form and in favorable cases may all be linear. This type of model may readily be applied to various hydrometallurgical systems. Mineral leaching is discussed in detail.

20962 (LBL—10478) **Electron oxidation of aromatic molecules and related delocalized-electron solids.** Tanzella, F.L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jan 1980. Contract W-7405-ENG-48. 108p. Dep. NTIS, PC A06/MF A01.

Thesis.

Syntheses for $C_6F_6AsF_6$ and $C_{10}F_8AsF_6$ were developed. $C_6F_5NAsF_6$ and $CF_3C_6F_5AsF_6$ were prepared from the interaction of O_2AsF_6 with pentafluoropyridine and octafluorotoluene. Pyrolysis of $C_6F_6AsF_6$, $C_6F_5NAsF_6$ and $CF_3C_6F_5AsF_6$ yields an equimolar mixture of the parent fluorocarbon and an isomer-specific cyclohexadiene. A mechanism for this decomposition involving F^- transfer from anion to cation is discussed. Hydrolysis of $C_{10}F_8AsF_6$ yields an equimolar mixture of $C_{10}F_8$ and an isomer-specific quinone $C_{10}F_8O_2$. A mechanism involving OH^- attack on the cation is presented. Benzene reacts with AsF_5 to give $(C_6H_5)_2AsF_2^+AsF_6^-$, which then reacts quantitatively with CsF to give $(C_6H_5)_2AsF_3$ and $CsAsF_6$. Interaction of $(C_6H_5)_2AsF_3$ with AsF_5 reconstitutes the fluoroarsonium salt. Variable temperature ^{19}F NMR studies show phi_2AsF_3 to be a rigid trigonal bipyramid, with the phenyl groups in equatorial positions, to 71°C. Interaction of benzene with O_2AsF_6 or $C_6F_6AsF_6$ yields a mixture of $(C_6H_5)_2AsF_2^+AsF_6^-$ and a poly(p-phenylene) salt (C_6H_4)/sub x/AsF_6 ($1.8 < x < 4.4$). A mechanism involving initial electron oxidation of benzene to give the radical cation intermediate $C_6H_6^+AsF_6^-$ is proposed. The moderate electrical conductivity of the polyphenylene salt indicates that it is a delocalized-electron solid. Preliminary results on the electron oxidation of naphthalene, anthracene and phenanthrene suggest the formation of AsF_6^- salts of these aromatics. Interaction of coronene with O_2AsF_6 or $C_6F_6AsF_6$ yields a dark-green mixture. The moderate electrical conductivity of the mixture indicates that at least one component in the mixture is a delocalized-electron solid.

20963 (SAND—80-6008) **Chemical processes during shock compression.** Adadurov, G.A.; Bavina, T.V.; Breusov, O.N.; Dremin, A.N.; Klopova, E.N.; Tatsii, V.F. (AN SSSR, Moscow. Inst. Novykh Khimicheskikh Problem). Apr 1980. Translated from Int. symp. explos. cladding, 1st; 1970: 223-237(1971). 14p. Dep. NTIS, PC A02/MF A01.

A critical examination of material in the literature concerning the occurrence of chemical processes in shock compression has shown that no correct proof has yet appeared showing that endothermic diffusion processes can take place actually during the short shock-wave transit times (especially for heterophase processes). In order to prove that such processes can take place, the authors proposed two methods: (a) the indicator-phase method and (b) the method of separating chemical decomposition products during the actual shock-wave transit time. The first method is based on the synthesis of high-pressure phases; the second is based on the use of the intense plastic flows that take place as a shock wave passes. It is shown that, when boron- and nitrogen-containing mixtures are subjected to shock compression, dense modifications of boron nitride are synthesized in low yield. A number of oxides can be decomposed actually during shock compression. The paper examines the possibility of explaining the unusually high rates of diffusion processes in shock compression. The outlook for the use of shock compression in chemical synthesis is evaluated, and the requirements that this method imposes on the selection and state of the starting reactants and on the experimental conditions are assessed.

20964 **Vapor-complex equilibria in the cobalt(II) chloride-indium(III) chloride system.** Kucera, G.H.; Papatheodorou, G.N. (Argonne National Lab., IL). *J. Phys. Chem.*; **83**: No. 25, 3213-3218(13 Dec 1979).

The vapor-phase equilibria of the cobalt(II) chloride-indium(III) chloride system have been investigated spectrophotometrically in the temperature range from 900 to 1100°K and at total pressures from ~ 0.5 to ~ 40 atm. Thermodynamic considerations imply the reaction $CoCl_2(s) + 2InCl_3(g) \rightarrow CoIn_2Cl_8(g)$ [ΔH = -19.2 kcal/mol; ΔS = -24.0 cal/(mol deg)]. Increasing the temperature and/or decreasing the indium chloride pressure tends to dissociate the blue $CoIn_2Cl_8$ complex according to the reaction $CoIn_2Cl_8(g) \rightarrow InCl_3(g) + CoInCl_5(g)$ [ΔH = 3.4 kcal/mol; ΔS = 33.4 cal/(mol deg)]. The values of the thermodynamic functions relevant to the formaton of $CoIn_2Cl_8$ are compared with those of other cobalt chloride vapor complexes and are interpreted as indicating similarities in the vapor structures.

20965 Solubility products of metal sulfides in molten salts. II. Measurements and calculations for lead sulfide in the LiCl-KCl and the LiCl-LiF eutectic compositions. Saboungi, M.L.; Marr, J.J.; Blander, M. (Argonne National Lab., IL). *Metall. Trans., B;* **10**: No. 4, 477-482(Dec 1979).

The solubilities of lithium sulfide and the solubility products of lead sulfide in the LiCl-KCl and LiCl-LiF eutectic mixtures have been measured by an electrochemical titration method in the temperature range from 673 to 823 K. At 823 K, the solubility of Li_2S in the LiCl-LiF eutectic was much larger than in the LiCl-KCl eutectic (1.95×10^{-2} compared with 3.50×10^{-3}). The measured solubility product of PbS in the LiCl-KCl eutectic (1.0×10^{-10} at 823 K) did not differ greatly from that in the LiCl-LiF eutectic (6.8×10^{-11} at 823 K). A priori calculations were made of the solubility products of PbS and several transition and heavy metal sulfides in the molten LiCl-KCl eutectic at 723 K. Fundamental theories of reciprocal and additive ternary molten salt solutions are used to explain the influence of the solvent on the solubilities of Li_2S and on the solubility products of PbS. The correlation of experiments with theory illustrates the utility of known theories of ionic systems in making predictions of solubilities and solubility products in ionic systems.

20966 Statistical mechanical theory for activity coefficients of a dilute solute in a binary solvent. Blander, M. (Argonne National Lab., IL); Saboungi, M.L.; Cerisier, P. *Metall. Trans., B;* **10**: No. 4, 613-622(Dec 1979).

A statistical mechanical calculation of the activity coefficients of a dilute solute, C, in a binary solvent, A-B, was made using a model for the interactions of a coordination cluster consisting of a solute atom and its neighboring solvent atoms. The derived equations are applicable to a variety of types of ternary solutions including substitutional and interstitial alloys as well as additive and reciprocal molten salts. The theory takes into accont the interactions between solute and solvent atoms (ions) as well as changes in interactions of the solvent atoms (ions) which are neighbors of solute atoms (ions). Prior theories such as those of Wagner and the quasi-chemical theories of Alcock and Richardson and Jacob and Alcock can all be shown to be special cases of the present theory. The dependence of the activity coefficients of a solute on the solvent composition is calculated from a knowledge of the activity coefficients of the solvent components, solute activity coefficients in the two pure solvent components, a coordination number, a geometric factor which depends upon the type of solution, and a term which represents the nonadditivity of pair bond interactions within the cluster of a solute atom (ion) and its neighboring solvent atoms (ions).In the model, the thermodynamic properties of the solute are related to the relative concentrations of the different coordination clusters as well as to the thermodynamic properties of the solvent. 5 figures.

20967 Relativistic effects on chemical properties. Pitzer, K.S. (Univ. of California, Berkeley). *Acc. Chem. Res.;* **12**: No. 8, 271-276(Aug 1979).

Special or anomalous chemical effects are examined in relation to periodic-table trends, and the degree to which these are relativistic effects are determined. It is noted that the degree to which these relativistic effects and the introduction of 4f electrons (the usual textbook explanation of the anomalies) affect chemical behavior are of ~ equal magnitude. The anomalies that are discussed in light of relativistic effects are (1) the lanthanide contraction; (2) the inert pair effect; and (3) the unique properties of Au (as compared to Ag and Cu), of Hg (as compared to Cd and Zn), and of U^{6+}, Np^{6+}, and Pu^{6+} (as compared to the corresponding lanthanides). 29 references are cited. (BLM)

20968 Relativity and the periodic system of elements. Pyykko, P. (Abo Akademi, Turku, Finland); Desclaux, J.P. *Acc. Chem. Res.;* **12**: No. 8, 276-281(Aug 1979).

Relativistic effects are defined as the difference between the case of a finite speed of light as in the world we live in and of an infinite speed of light as assumed by most theoretical chemistry. Ways in which these relativistic effects can be used to explain some of the most conspicuous anomalies in the latter half of the periodic table comprise this article. These relativistic effects are found to be particularly strong around gold in the table. (BLM)

20969 Production of $B_{10}H_{14}$ from B_2H_6 at room temperature by laser induced chemistry using df laser. Merritt, J.A. US Patent 4,144,151. 13 Mar 1979. Filed date 12 Jun 1978. 5p.

A method for the production of $B_{10}H_{14}$ by laser induced chemistry is disclosed. A DF laser is used to irradiate a laser reaction cell containing diborane (B_2H_6). The P12 (2611 cm to the -1) frequency of the 1-0 band of the DF laser is resonant with the v8 (2614 cm to the -1) vibrational fundamental of $B_2HZ&$ and starts a chain reaction producing solid white crystals of $B_{10}H_{14}$ that condense on the walls of the laser reaction cell. The method is carried out at room temperature. Thus, the chemical engineering is very simple. The $B_{10}H_{14}$ produced is of high purity and high yield. The production of decaborane-14 from diborane by DF laser induced chemistry (LIC) represents an efficient synthesis of a large polyatomic molecule of high purity by LIC. (Author)

20970 F/sub N/: a criterion for rating powder diffraction patterns and evaluating the reliability of powder-pattern indexing. Smith, G.S.; Snyder, R.L. (Univ. of California, Livermore). Contract W-7405-ENG-48. *J. Appl. Crystallogr.;* **12**: 60-65(1979).

At present, over 30,000 powder diffraction patterns are available as references. It is proposed that the patterns on file as well as new patterns submitted for publication be assigned quantitative quality factors. A simple-to-use figure of merit, covering both accuracy in the measurement of the positions of the diffraction lines and completeness of the pattern, is derived. This figure of merit provides a rapid evaluation of powder patterns, in much the same way as the R factor provides a rating for single-crystal structure determinations. This figure of merit also provides a means to assess the reliability of a unit derived solely from powder data. The present F/sub N/ ranking scheme is shown to be superior to de Wolff's M_{20} for ranking patterns. It is recommended that use of the latter be discontinued for that purpose. Guidelines are given on the use and implementation of the F/sub N/ rating of powder diffraction patterns.

20971 Measurement of the energy exchange between scattered and ejected electrons following autoionisation of the $2s2p^6 3s(^1S)$ state of Ne. Spence, D. (Argonne National Lab., IL). *J. Phys., B (London);* **11**: No. 7, L243-L247(1978).

Measurements of the energy exchange, ΔE, between scattered and ejected electrons following autoionization of the $2s2p^6 3s(^1S)$ state of Ne reveal that for sufficiently low values of excess energy E_1, ΔE is no longer proportional to $E_1^{-1\ 2}$, in accordance with a quantum-mechanical model of Bottcher and Schneider which includes dynamical screening of the ion core.

20972 Di-μ-chloro-bis[heptaaquapraseodymium(III)] tetrachloride $[(H_2O)_7PrCl_2Pr(H_2O)_7]Cl_4$. Habenschuss, A.; Spedding, F.H. (Ames Lab., IA). *Cryst. Struct. Commun.;* **7**: 535-541(1978).

The crystal and molecular structure of $PrCl_3.7H_2O$ was studied using four circle diffractometry and counter techniques. The structure was found to be two nine coordinated praseodymium ions forming a dimer through two bridging chlorine coordinated to both metal ions. Seven water molecules bound to each praseodymium completed the nine coordination. The remaining four chlorine were found to not be bound to the metal ions. Values of the fractional coordinates, the thermal parameters, and selected interatomic distances and angles for the nonhydrogen atoms in the compound are tabulated.

20973 Crystal structures of sodium sulfate decahydrate (Glauber's salt) and sodium tetraborate decahydrate (borax). Redetermination by neutron diffraction. Levy, H.A.; Lisensky, G.C. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Acta Crystallogr.;* **B34**: 3502-3510(1978).

Single-crystal neutron-diffraction data with full-matrix least-squares refinements have yielded precise locations for all atoms (for the H atoms in particular), in both compounds. Hydrogen bonding with H atom sites disordered with equal occupancy, as previously postulated to be the source of zero-point entropy in the sulfate, is quantitatively verified. A thermally excited vibrational mode of the sulfate ion involving a rearrangement of hydrogen bonding has been found. The two structures, which have closely similar chains of Na ions with coordinated water molecules, are compared in detail. Measures of disagreement are: for the sulfate, $R(F^2) = 0.082$ for 1750 $F^2 > \sigma(F^2)$; for the borate, $R(F^2) = 0.060$ for 1837 $F^2 > \sigma(F^2)$. 6 figures, 6 tables.

ORGANIC CHEMISTRY

REFER ALSO TO CITATION(S) 19955

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 19940, 20962

20974 (AD-A—072727) High temperature gas energy transfer. Annual summary report 1 Aug 1978-31 Jul 1979. Rabinovitch, B.S. (Washington Univ., Seattle (USA). Dept. of Chemistry). 7 Aug 1979. Contract N00014-75-C-0690. 9p. NTIS, PC A02/MF A01.

Work under this contract is summarized. Results on collisional transfer of vibrational energy of gases and temperature dependence of transfer efficiency by the Diffusion Cloud method are described. New results by a novel and simple Variable Encounter Method for the study of vibrational energy transfer between gas molecules and a wall, at high temperatures and levels of activation, in the transient region are reported; cyclopropane and cyclobutane have been studied.

20975 (PB—298964) **Fungal degradation of kraft lignin and lignin sulfonates prepared from synthetic 14C-lignins.** Lundquist, K.; Kirk, T.K.; Connors, W.J. (Forest Products Lab., Madison, WI (USA)). Sep 1976. 30p. NTIS, PC A03/MF A01.

Kraft lignins (KL), bleached kraft lignins (BKL), and lignin sulfonates (LS) were prepared from synthetic (14)C-lignins labeled in the aromatic nuclei or in the propyl side chains. These and control lignins (CL) were incubated with the lignin-decomposing white-rot fungus, Phanerochaete chrysosporium Burds., in a defined culture medium containing cellulose as growth substrate. Decomposition was monitored by measuring the (14)CO2 evolved. Average percentages of the (ring-(14)C)- and (side chain-(14)C)-lignins, respectively, recovered as (14)CO2 at the cessation of (14)CO2 evolution were: KL, 41 and 31; BKL, 42 and 26; LS, 28 and 21; and CL, 26 and 24. Gel permeation chromatography of radiolabeled materials extracted from spent cultures showed that substantial degradation to nonvolatile products had occurred. The polymeric components in the extracts were further degraded in fresh cultures. These results indicate that industrial lignins are significantly bioalterable, and that under favorable conditions industrial lignins are substantially biodegradable. Millions of tons of kraft lignin and lignin sulfonates are produced annually, but value derived from them as commercial products is relatively low. This is despite long-term research efforts to use industrial lignins or derivatives as polymeric materials or as a source of organic chemicals. The tremendous potential for use of industrial lignins is apparent.

20976 (SAND—80-6006) **Polymerization in shock compression.** Babare, L.V.; Dremin, A.N.; Pershin, S.V.; Yakovlev, V.V. (AN SSSR, Moscow. Inst. Khimicheskoj Fiziki). Apr 1980. Translated from Int. symp. explos. cladding, 1st; 1970: 239-257(1971). 18p. Dep. NTIS, PC A02/MF A01.

A fairly wide range of liquid and crystalline monomers has been subjected to polymerization (up to pressures of 100 kbar), and the range in which the process occurs with some of them has been established for some of them. It has been shown that polymerization occurs both with polymers polymerizing under ordinary conditions by the radical or the ionic mechanism, and that it can take place at a double or triple bond, as well as with ring opening. Under specific conditions of shock compression, polymerization can be accomplished with compounds which normally are difficult or impossible to polymerize. It has been shown that polymerization takes place within a few milliseconds, at pressures at which the density of the monomer reaches that of the polymer. The effect of pressure in shock compression and the number of reflected waves on the yield and length of the resulting polymeric chain has been studied. Conductivity has been observed in the region of polymerizing pressures. It has been found that the action of the shock wave does not rest mainly on thermal effects but is determined by the specific nature of the shock loading.

20977 **1,2 hydrogen shift: a common vehicle for the disappearance of evanescent molecular species.** Schaefer, H.F. III. (Univ. of California, Berkeley). *Acc. Chem. Res.;* **12**: No. 8, 288-296(Aug 1979).

Studies of the 1,2 hydrogen shift in carbenes, nitrenes, and vinylidenes are reviewed. The key role of this isomerization in these unstable intermediates in organic reactions is elucidated. Isomerization possibilities of the as yet unidentified H_2CN^+ in the formation of HCN and HNC in interstellar space is discussed. The photodissociation of formaldehyde is explained on the basis of an unstable intermediate, hydroxycarbene. 94 references are cited. (BLM)

20978 **Triphase catalysis.** Regen, S.L. (Marquette Univ., Milwaukee, WI). *Angew. Chem. Int. Ed. Engl.;* **18**: No. 6, 421-492(Jun 1979).

Triphase catalysis (TC) has recently been introduced as a unique form of heterogeneous catalysis in which the catalyst and each of a pair of reactants are located in separate phases. Based on this concept, new synthetic methods have been developed for aqueous phase-organic phase reactions using a solid phase catalyst. Although it is only at an early stage of development, TC shows considerable potential for practical use. Our mechanistic understanding of these highly complex catalytic systems is at present very limited and detailed examination will be required before their relationship to phase-transfer, micellar, and interfacial catalysis becomes clear.

20979 **Electronic spectroscopy of polyatomic molecules by low-energy, variable-angle electron impact.** Kuppermann, A.; Flicker, W.M.; Mosher, O.A. (California Inst. of Tech., Pasadena). Contract EY-76-S-03-767. *Chem. Rev.;* **79**: No. 1, 77-90(1979).

The paper is a review and evaluation of some of the work done in this field over the last few years. Compounds discussed are polyatomic molecules, ethylene, fluoroethylenes, alkynes, polyenes, benzene and fluorobenzenes, five-membered heterocycles, and azo compounds. 124 references, 16 figures, 1 table.

20980 **Photoelectron angular distributions of carbon-carbon π electrons in ethylene, benzene, and their fluorinated derivatives.** Sell, J.A.; Mintz, D.M.; Kuppermann, A. (California Inst. of Tech., Pasadena). Contract EY-76-S-03-767. *Chem. Phys. Lett.;* **58**: No. 4, 601-605(15 Oct 1978).

We have measured tha anisotropy parameter β describing the angular distribution of C-C π electrons photoejected by 584 A radiation from benzene, ethylene, and most of their fluorinated derivatives. The results indicate that in going from C_2H_4 to C_2F_4, the value of β at the maximum intensity of the C-C π band decreases from 1.25 +- 0.05 to 0.05 +- 0.04, whereas in going from C_6H_6 to C_6F_6 it decreases from 1.23 +- 0.04 to 0.65 +- 0.04. The differences in these variations are attributed to the differences in the interactions of the F π electrons with the C-C π electrons in these two series of molecules. If such correlations between these interactions and β values turn out to be generally valid, a determination of β could help elucidate the nature of bonding interactions in other molecules. 28 references, 3 figures, 1 table.

20981 **Angular distributions in the photoelectron spectra of benzene and its monohalogenated derivatives.** Sell, J.A.; Kuppermann, A. (California Inst. of Tech., Pasadena). Contract EY-76-5-03-767. *Chem. Phys. (Amsterdam);* **33**: 367-378(1978).

The results of measurements of the photoelectron angular distributions of benzene, fluorobenzene, chlorobenzene, bromobenzene, and iodobenzene are presented. Trends in the asymmetry parameters β as well as in the band positions and shapes across this series of molecules lead to assignments of all of the π orbitals and some of the σ orbitals associated with the features in the spectra. 47 references, 5 figures, 5 tables.

20982 **4,4'-dichlorobiphenyl: crystal packing in para-substituted biphenyls.** Brock, C.P. (Univ. of Kentucky, Lexington); Kuo, M.S.; Levy, H.A. *Acta Crystallogr.;* **B34**: 981-985(1978).

$C_{12}H_8Cl_2$, monoclinic, $P2_1/n$,a = 15.780 (4), b = 13.740 (4), c = 9.682 (3) A, β = 96.23 (3)°, Z = 8, M/sub r/ = 233.10, D/sub c/ = 1.420, D/sub m/ = 1.39 (1) g cm^{-3}. The molecules are arranged in the unit cell with their long directions approximately parallel to b; in projection on the ac plane these axes form a pseudohexagonal array. This crystal is isostructural with several other biphenyl derivatives, and like them has a twist angle between the phenyl rings close to the expected mean gas-phase value of 42°. 3 figures, 3 tables.

20983 **Quenching of biacetyl (^{3}A/sub u/) molecules by near-resonant and off-resonant collisional partners.** Wampler, F.B.; Oldenborg, R.C. (Los Alamos Scientific Lab., NM). *Int. J. Chem. Kinet.;* **10**: 1225-1232(1978).

Laser-induced time-resolved phosphorescence has been used to evaluate the quenching of gaseous biacetyl (^{3}A/sub u/) molecules by various molecules at 25°C. The quenching of biacetyl(^{3}A/sub u/) molecules by biacetyl itself was not detectable under our experimental conditions, and a pressure-independent lifetime of 1.70 +- 0.08 msec was found. The bimolecular rate constants (units of l/mol.sec) for quenching of the ^{3}A/sub u/ molecules by cis-2-pentene, trans-2-pentene, cis-1,3-pentadiene, trans-1,3-pentadiene, and oxygen were found to be (3.3 +- 1.9) x 10^3, (4.0 +- 0.2) x 10^4, (3.9 +- 0.1) x 10^8, (1.3 +- 0.1) x 10^8, and (5.2 +- 0.4) x 10^8, respectively. (3 figures, 1 table).

20984 **Coexistence curve of a binary mixture.** Jacobs, D.T.; Anthony, D.J.; Mockler, R.C.; O'Sullivan, W.J. (Univ. of Colorado, Boulder). Contract E(11-1)-2203. *Chem. Phys. (Amsterdam);* **20**: 219-226(1977).

Precise measurements of the refractive index as a function of temperature in the one- and two-phase region near the consolute point in the binary mixture methanol-cyclohexane are reported. By measuring forty-four data points over four decades in ϵ = (T/sub c/ - T)/T/sub c/, 6 x $10^{-6} < \epsilon < 6 \times 10^{-2}$, the coexistence curve was determined and critical exponent β was found to be 0.326 +- 0.003 by using properly weighted least squares fit to the data. The uncertainty is three times the standard deviation. The data is consistent with other refractive index data of the same binary fluids although a different value for the critical exponent was found. A need was not found for the Wegner type correction terms reported by others recently.

20985 (SAND—80-6003) **Chemistry of shock compression.** Dremin, A.N.; Breusov, O.N. Translated from *Priroda (Moscow);* No. 12, 10-17(1971). 16p. Dep. NTIS, PC A02/MF A01.

Chemical effects of explosions are discussed in this article. The mechanical effects (comminution, creation of point defects, etc.) are considered first. The shock compression can and does lead to rapid phase transformations; often secondary changes after the shock wave passes are involved. To induce chemical reactions at high pressures, mass transfer must also be provided; if the mixture components are previously ground to 1.0 to 0.1 mμ size, the reaction can be completed during the period of shock compression (10^{-5} s). The shock wave also produces high temperatures which can be utilized. Organic compounds can undergo degradation and polymerization under shock compression. (DLC)

ELECTROCHEMISTRY

20986 (SAND—80-6005) **Electrochemical phenomena in the shock compression of dielectrics.** Yakushev, V.V.; Dremin, A.N. (AN SSSR, Moscow). Apr 1980. Translated from Int. symp. explos. cladding, 1st; 1970: 259-266(1971). 11p. Dep. NTIS, PC A02/MF A01.

The development of electric signals when nonpolar substances are subjected to dynamic loading was studied on the example of CCl_4. It was concluded that these signals were due to electrochemical processes taking place at the interface of the metal-CCl_4 shock-compressed phases and thus were linked with the presence of ions in the compressed material. It was shown that electrochemical processes may arise in the electrode regions in other shock-compressed materials, both polar and nonpolar.

20987 **Transport equations for a mixture of two binary molten salts in a porous electrode.** Pollard, R.; Newman, J. (Univ of Calif, Lawrence Berkeley Lab). *J. Electrochem. Soc.;* **126**: No. 10, 1713-1717(Oct 1979).

Concentrated solution theory is generalized to provide a framework for the description of isothermal transport processes in a mixture of two binary molten salts with a common ion. Electrochemical flux equations are derived for several commonly used reference velocities. Nonsteady-state material balances and conservation equations, based on the macrohomogeneous theory of porous electrodes, are also presented, together with a relationship for the ohmic potential drop in the solution. These equations can be used in conjunction with information on electrode kinetics to predict the behavior of molten salt electrolytes in porous media or in free electrolytic solutions. This work finds application in fuel cells, electric batteries, and electric vehicle propulsion. 13 refs.

20988 **Potential distribution for disk electrodes in axisymmetric cylindrical cells.** Pierini, P.; Newman, J. (Ariz State Univ, Tempe). *J. Electrochem. Soc.;* **126**: No. 8, 1348-1352(Aug 1979).

A cylindrical cell useful for rotating disk studies has been analyzed for its primary resistance. Values of the resistance are given for a large number of cell configurations. The resistance calculations permit the simpler resistance formulas for infinite cells to be applied to the design of finite cells.

20989 **Anomalously intense Raman scattering at the solid-electrolyte interface.** Furtak, T.E. (Ames Lab., IA). *Solid State Commun.;* **28**: 903-906(1978).

The enhanced Raman effect is used to characterize cyanide on silver at the interface with 0.1 M Na_2SO_4 + 0.01 M KCN solution. We conclude the bond is polarized with considerable backbonding. The scattering intensity dependence on electrode voltage supports enhancement models which involve wavefunction overlap between the metal and the adsorbate. 1 figure.

PHOTOCHEMISTRY

REFER ALSO TO CITATION(S) 20958, 20977

20990 (COO—4685-2) **Photochemical activation and reactivity of polynuclear transition metal complex molecules. Progress report, June 1979-May 31, 1980.** Endicott, J.F.; Lintvedt, R.L. (Wayne State Univ., Detroit, MI (USA)). Feb 1980. Contract ER-78-S-02-4685. 8p. Dep. NTIS, PC A02/MF A01.

During this contract year several new ligands and binuclear metal complexes have been prepared including many that can be expected to exhibit long-lived excited states. The metal ions represented are Cu(II), Ni(II), Co(II), Mn(II), Cr(III), Ti(IV), V(IV), U(VI), and Pd(II). In addition, many mononuclear complexes that are precursors in the formation of heterobinuclear complexes were prepared. These include complexes of Cu(II), Ni(II), Pd(II), and Ru(II). Many of these compounds will be used in photochemical and electron transfer studies. Polarographic, cyclic voltammetric and coulometric studies have been carried out on a number of binuclear Cu(II) triketonates and their Schiff-base derivatives. Most of these compounds undergo reversible or quasi-reversible two electron transfer reactions which makes them potetially useful electron transfer reagents. Much of the electrochemical data can be rationalized by the formation of dimers which are new electroactive species. The importance of such species in multi-electron transfer processes is being investigated.

20991 (DOE/ER/05528—18) **Reductive photoalkylation of anthracene.** Fox, M.A.; Madany, I.M. (Texas Univ., Austin (USA). Dept. of Chemistry). 1980. Contract EG-77-S-05-5528. 7p. (CONF-800303—16). Dep. NTIS, PC A02/MF A01.

From 179. national meeting of the American Chemical Society; Houston, TX, USA (23 Mar 1980).

Results support previous observations that stilbene cis/trans isomerization can be explained by a reversible photochemical electron transfer and increase the suspicion that photoinduced electron transfer may be the most important primary photoprocess in stable carbanions. (DLC)

20992 **Heteronuclear recombination of chlorine and iodine atoms.** Burns, G. (Univ. of Toronto, Ontario); Lampe, F.W. *J. Phys. Chem.;* **83**: No. 25, 3308(13 Dec 1979).

Various works dealing with the flash photolysis studies of ICl are discussed. Some results wherein relatively inert bodies such as N_2 and CO_2 are reported to catalyze the formation of ICl much faster than the homonuclear recombination that produces I_2 or Cl_2 are questioned and reexamined. Results of recent studies indicate that 99% of the Cl atoms will have reacted within a period of 4 μs. Since all reaction times reported in the flash photolysis studies were measured from 50 μs after the onset of the flash, essentially all the Cl atoms are thought to have disappeared before any measurements could have been made. The authors then conclude that reported values for the rate constant for heteronuclear recombination of Cl atoms did not actually have any basis of fact, but the values reported for the ICl catalyzed recombination of I atoms are considered to be valid.

RADIATION CHEMISTRY

REFER ALSO TO CITATION(S) 20184

20993 **One-electron redox potentials and rate of electron transfer in aqueous micellar solution. Partially solubilized quinones.** Almgren, M.; Grieser, F.; Thomas J.K. (Univ. of Notre Dame, IN). *J. Phys. Chem.;* **83**: No. 25, 3232-3236(13 Dec 1979).

The electron transfer equilibrium between AQS/AQS^- and DQ/DQ^- (where AQS is sodium 9,10-arthraquinone-2-sulfonate and DQ, duroquinone) has been studied by pulse radiolysis in aqueous micellar solutions of sodium lauryl sulfate. The equilibrium constant is changed as would be expected if AQS, AQS^-, and DQ- were all mainly in the aqueous solution, and DQ distributed between the micelles and the aqueous phase with a distribution constant of K/sub D//N = 150 M^{-1}, in agreement with the independently determined value of this constant. The kinetics of the equilibration show, however, that electron transfer at the micelle surface is important, indicating that also AQS and DQ^- are associated with the micelle to some extent. With reasonable assumptions regarding the distribution constants of these species (that have some independent support), the observed catalytic effect of the micelles on the electron transfer from DQ^- to AQS can be understood.

20994 **Radioracemization of isovaline. Cosmochemical implications.** Bonner, W.A.; Blair, N.E.; Lemmon, R.M.; Flores, J.J.; Pollock, G.E. (Univ. of California, Berkeley). *Geochim. Cosmochim. Acta;* **43**: No. 11, 1841-1846(Nov 1979).

The optically pure D- and L-enantiomers (I), which cannot be racemized by ordinary chemical mechanisms involving α-hydrogen removal, and which has been isolated in apparently racemic form from the Murchison meteorite, have been subjected to partial radiolysis by the ionizing radiation from a 300 Ci ^{60}Co γ-ray source. Both in the anhydrous and hydrated solid states and as solid sodium or hydrochloride salts each enantiomer suffered significant radioracemization of the undestroyed residue during its partial radiolysis. The sodium salt of isovaline in 0.1 M aqueous solution suffered extensive radiolysis with relatively small radiation doses, but showed no detectable radioracemization. The significance of these observations with respect to the primordial enantiomeric composition of the isovaline (and other amino acids) indigenous to meteroties is discussed.

20995 **Pulse radiolysis studies in model lipid systems: formation and behavior of peroxy radicals in fatty acids.** Hasegawa, K.; Patterson, L.K. (Univ. of Notre Dame, IN). *Photochem. Photobiol.;* **28**: 817-823(1978).

Radiolytic formation and peroxidation of fatty acid radicals have been investigated by pulse radiolysis techniques in oleate, linoleate, linolenate and arachidonate systems. A strong absorption band at 280 nm associated with conjugated radicals, R/sub conj/., formed in polyunsaturated fatty acid moieties has been used as a probe for kinetic processes occurring at doubly allylic sites in the hydrocarbon chain. Formation of R/sub conj/. by O^- has been found to be more efficient than the less selective OH radical. Peroxidation of R/sub conj/. is shown to be somewhat slower, (k/sub R.+O_2 ~ 3 x 10^8 $M^{-1}s^{-1}$), than O_2 reactions with radicals in oleate (k/sub R+O_2 = 1 x 10^9 $M^{-1}s^{-1}$). Peroxy radicals generated in these reactions disappear slowly be essentially second order processes (2k/sub RO_2/ ~ 10^7 $M^{-1}s^{-1}$). The superoxide radical, O_2^-, shows little if any reactivity towards 0.01 M linolenate or arachidonate over periods of 20s. 3 figures, 1 table.

RADIOCHEMISTRY AND NUCLEAR CHEMISTRY

20996 Survey of reducing agents for the synthesis of tetraphenylarsonium oxotechnetiumbis(ethanedithiolate) from [^{99}Tc]pertechnetate in aqueous solution. Jones, A.G.; Orvig, C.; Trop, H.S.; Davison, A.; Davis, M.A. (Harvard Medical School, Boston, MA). *J. Nucl. Med.;* **21**: No. 3, 279-281(Mar 1980).

We have studied the effectiveness of various reducing agents in the production of the well-characterized complex $[^{99}TcO(SCH_2CH_2S)_2]^-$ from pertechnetate and ethanedithiol in aqueous solution. The reductants tested included sodium dithionite, hypophosphorous acid, formamidine sulfinic acid, dithiothreitol, hydrazine, and hydroxylamine. Of these, only sodium dithionite in the pH range 11 to 13 was found to give quantitative yields of the required technetium complex.

HOT-ATOM CHEMISTRY

20997 (COO—1617-63) **High energy halogen atom reactions activated by nuclear transformations. Progress report, February 15, 1979-February 14, 1980.** Rack, E.P. (Nebraska Univ., Lincoln (USA). Dept. of Chemistry). Feb 1980. Contract FY-76-S-02-1617. 41p. Dep. NTIS, PC A03/MF A01.

The program consists of six interrelated areas: (1) Reactions of iodine with alkenes and alkynes activated by radiative neutron capture and isomeric transition in low pressure gaseous systems employing additives and rare gas moderators, high pressure, and liquid systems. Special attention was given to the reactivity of excited complex formation and structural effects of electrophilic iodine attack on various pi-bond systems. (2) The gas-to-condensed phase transition in halogen high energy chemistry. Current interest involves the study of caging effects of an ice lattice on recombination reactions involving neutron-irradiated frozen aqueous solutions of halogenated organic and biochemical solutes in order to learn more about kinetic energy effects, halogen size, solute molecule size, steric effects and hydrogen bonding within an ice lattice cage. (3) Systematics of halogen hot atom reactions. The reactions of /sup 80m/Br, ^{80}Br, /sup 82m/Br + ^{82}Br, ^{82}Br, ^{82}Br, ^{128}I, ^{130}I, and /sup 130m/I + ^{130}I activated by radiative neutron capture or isomeric transition in hydrocarbons and halo-substituted alkanes in low pressure and high pressure gaseous systems employing additives and rare gas moderators are currently being studied. (4) Mathematical and computer simulation studies of caging events within an ice lattice are being investigated. (5) At Brookhaven National Laboratory, cyclotron-produced chlorine and fluorine hot atoms substitution reactions with molecules possessing a single chiral center are under investigation. Experiments are being performed in an attempt to determine the role of hot atom kinetic energy, halogen atom, enantioner structure, steric effects and phase on the extent of substitution by retention of configuration or by Walden inversion. (6) The applications of high energy techniques and concepts to neutron activation analysis for trace elements and trace molecule determinations in biological systems was continued.

20998 Primary processes in hot-atom chemistry. Carlson, T.A. (Oak Ridge National Lab., TN). pp 13-37 of Chemical effects of nuclear transformations in inorganic systems. Harbottle, G.; Maddock, A.G. (eds.). New York, NY; North-Holland Publishing Co. (1979).

Three sources of excitation are important to the primary processes in hot atom chemistry. They are (1) the recoil energy which is imparted to the hot atom; (2) the readjustment to a vacancy in an inner shell of an atom by a series of Auger processes; (3) electronic excitation and ionization that arise from the process known as electron shake-off. The following processes for specific cases in nuclear decay are summarized: (1) beta decay; (2) positron decay; (3) alpha decay; (4) gamma transition; (5) internal conversion; (6) electron capture; (7) nuclear reactions; (8) fission. 13 figures, 2 tables.

PROPERTIES OF RADIOACTIVE MATERIALS

REFER ALSO TO CITATION(S) 21268, 21271, 21329

20999 (LBL—10348) **Cyclooctatetraeneactinide(IV) bis-borohydrides.** Solar, J.P.; Streitwieser, A. Jr.; Edelstein, N. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1979. Contract W-7405-ENG-48. 13p. (CONF-790917—21). Dep. NTIS, PC A02/MF A01.

From American Chemical Society national meeting; Washington, DC, USA (10 Sep 1979).

In order to take advantage of the known volatility of actinide borohydride complexes, attempts were made to prepare half-sandwich borohydrides $(RCOT)M(BH_4)_2$, where COT is cyclooctatetraene and M is Th or U. The borohydrides were formed as complexes with THF solvent. Spectra and chemical reactions of these compounds were investigated. (DLC)

21000 Tritium labeling of organic compounds deposited on porous structures. Ehrenkaufer, R.E.; Wolf, A.P.; Hembree, W.C. (to Dept. of Energy). US Patent 4,162,142. 24 Jul 1979. Filed date 29 Jun 1978. 6p.

PAT-APPL-920,412.

An improved process for labeling organic compounds with tritium is carried out by depositing the selected compound on the extensive surface of a porous structure such as a membrane filter and exposing the membrane contaning the compound to tritium gas activated by the microwave discharge technique. The labeled compound is then recovered from the porous structure.

COMBUSTION, PYROLYSIS, AND HIGH-TEMPERATURE CHEMISTRY

REFER ALSO TO CITATION(S) 20031, 20034

21001 (AD-A—072623) **An investigation of the ignition delay times for propylene oxide-oxygen-nitrogen mixtures. Interim technical report.** Meister, E.E. III. (Illinois Univ., Urbana (USA). Dept. of Aeronautical and Astronautical Engineering). Oct 1978. 37p. NTIS PC A03/MF A01.

A reflected shock tube technique has been used to measure the ignition delay time for propylene oxide-oxygen-nitrogen mixtures in the temperature range of 900 to 1250 deg K. Ignition delay times were measured by using both streak schlieren and pressure gauges mounted on the back wall of the shock tube. A regression analysis indicated that the delay time multiplied by the propylene oxide concentration to the .8 power and the oxygen concentration to the -1.2 power yielded a best fit when plotted as a logarithm against the reciprocal temperature. This regression analysis also indicated that the nitrogen concentration had no effect on the ignition delay time. The apparent activation energy for the reaction was found to be approximately 19 kcal joule/mole.

21002 (FE—2650-T1) **Formation of NO/sub x/ and other products from chemically bound nitrogen in coal combustion. Second quarterly technical report, 1 July-30 September 1978.** Blair, D.W.; Wendt, J.O.L. (Exxon Research and Engineering Co., Linden, NJ (USA). Government Research Labs.). Mar 1979. Contract EF-77-C-01-2650. 135p. Dep. NTIS, PC A07/MF A01.

This program is designed to determine and model the mechanism of conversion of nitrogen and other elemental species in coal to combustion products during the combustion of that fuel. To this end, the combustion process is being viewed as occurring in several distinct stages and these stages are being studied individually. These studies are both experimental and theoretical. This is a progress report of results which pertain to the initial pyrolysis stage of combustion. Experimental results are reported which show the fraction of coal mass, nitrogen, and sulfur volatilized in argon from 500 C to 1500 C. Theoretical results have been used to develop a computer code that will be used in determining time-resolved rates of mass evolution of volatile products from pyrolyzing coal particles.

21003 Frank-kamenetskii problem revisited--1. boundary conditions of first kind. Gill, W.; Donaldson, A.B.; Shouman, A.R. (Sandia Lab, Albuquerque, NM). *Combust. Flame;* **36**: No. 3, 217-232(Nov 1979).

The classical steady-state thermal ignition problem in the three one-dimensional geometries is considered. The well-known method of expanding the exponent first suggested by Frank-Kamenetskii is modified by performing the expansion about the unknown midplane temperature. Analytical expressions were obtained for the critical conditons that will allow the handling of more complex boundary conditions. The results are compared with the existing exact and numerical solutions. 11 refs.

ENGINEERING

FACILITIES AND EQUIPMENT

REFER ALSO TO CITATION(S) 21121

21004 (BNWL-SA—5289(Rev.)) **Fundamentals of corrosion control design.** Perrigo, L.D.; Jensen, G.A. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Mar 1979. Contract EY-76-C-06-1830. 17p. (CONF-7905147—1). Dep. NTIS, PC A02/MF A01.

From Western states corrosion seminar; Pomona, CA, USA (1 May 1979).

The development of corrosion control design principles and practice is discussed. It is concluded that by applying simple and straightforward principles to the design of systems, buildings and equipment, operational corrosion problems may be reduced or avoided. These corrosion control design principles are concerned with promoting the use of orientation, layout, and configuration to avoid the holdup of solutions, abrupt flow changes, impingement and stagnant areas. Climatic conditions and terrain are important siting considerations in reducing atmospheric corrosion of buildings and facilities. A determined effort is needed to broaden the understanding of anticorrosion design measures and principles because these are not widely known and recognized by designers and architects.

21005 Theoretical analysis of evaporation and vapor flow between two parallel planes. Heilmann, W.J. (Institut de Recherche de l'Hydro-Quebec, Varennes); VanSant, J.H. *Lett. Heat Mass Transfer;* 6: No. 5, 355-364(Sep 1979).

Pressure, temperature and velocity distributions were computed for vapor flow originating by the evaporation from one surface of a space bounded by parallel planes. A finite difference method was employed using dimensionless parameters with the inclusion of a generalized expression for the saturation temperature-pressure relation of selected fluids. Results indicate that the ordinarily neglected dissipation and volume work functions should not be omitted from the energy equation and that a simplified method using an adiabatic pressure gradient expression for estimating temperature changes gives erroneous results.

21006 (SAND—79-2182) **Sandia Laboratories Radiant Heat Facility.** Adams, P.H.; Class, P.L.; Nakos, J.T.; Strait, B.G. (Sandia Labs., Albuquerque, NM (USA)). Feb 1980. Contract EY-76-C-04-0789. 88p. Dep. NTIS, PC A05/MF A01.

This report outlines the capabilities and limitations of the Radiant Heat Facility; describes completely the two main types of testing equipment, i.e., quartz lamps and graphite resistor heater arrays; outlines the data acquisition capabilities and instrumentation techniques; and gives a short discussion of the theory of radiation heat transfer.

21007 (SAND—80-0190) **Current problems in the finite difference solution of stress waves.** Herrmann, W. (Sandia Labs., Albuquerque, NM (USA)). Feb 1980. Contract EY-76-C-04-0789. 36p. Dep. NTIS, PC A03/MF A01.

An attempt is made to outline the current state of the art in finite-difference calculations of non-linear stress wave propagation in solids, with special emphasis on the solution of large-scale engineering problems. Production software exists, with flexible user-oriented features, which enable that analyst to achieve satisfactory engineering solutions for many complex problems in a cost-effective manner. Considerations of computer resource economics show that one-dimensional calculations of even exceedingly complex problems can be performed at small cost on small computers. Very complex two-dimensional calculations can be performed, but may require the largest computers and entail significant costs. Three-dimensional calculations which resolve details of stress waves are orders of magnitude beyond the capabilities of present and near term computers, although three-dimensional solutions can be useful for quasi-steady problems or problems where detailed resolution is not necessary. Computational costs can be reduced by further development of finite-difference methods, although order of magnitude improvement required for a real enhancement of capability is expected to require the development of methods quite different from those in use at this time. Significant improvements can be achieved through attention to software development, in efficiency, reliability and the provision of user-oriented interactive problem definition and the display of results.

21008 (UCRL—83721) **Electromagnetic propulsion: drag and erosion modeling.** Buckingham, A.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Apr 1980. Contract W-7405-ENG-48. 10p. (CONF-800620—1). Dep. NTIS, PC A02/MF A01.

From 16. AIAA-SAE-ASME joint propulsion conference; Hartford, CT, USA (30 Jun 1980).

Railgun electromagnetic accelerators are currently being designed for hypervelocity projectile launch in equation of state impact experiments. Launcher development is proceeding in successive stages of increased acceleration and velocity with a goal of launching sabot-supported 1 g projectiles at speeds near 100 km/s. The railgun utilizes Lorentz force produced by the current in an electrically conducting moving armature interacting with the fields of two parallel electrically conducting rails. The armature consists of a plasma sheath that completes an expanding current loop at the base of the projectile accelerating it. Projectile aerodynamics during launch and free flight, plasma leakage past the projectile, stress deformation of rails and projectile, projectile/rail heating with material erosion, drag and influences on launch ballistics are all recognized as severe design problems. Of these, friction, drag and erosion and their influence on launch acceleration are the emphasis of this work. The history of candidate projectile material response is traced sequentially from start of motion. The analysis includes: sliding friction with projectile deformation, followed, where appropriate, by liquid metal and multiphase erosive viscous interface layer development, heat, mass and momentum transport and subsequent launch ballistics calculations incorporating the influence of these physical considerations. Several preferred candidate materials and sabot/projectile configurations emerge from these computational studies.

21009 (UVA-ER—522-79U) **Rotor model.** Hendricks, S.L.; Junkins, J.L. (Virginia Univ., Charlottesville (USA). School of Engineering and Applied Science). Sep 1979. Contract EY-76-C-05-1779. 75p. Dep. NTIS, PC A04/MF A01.

The development of a program to find the frequencies and modes of vibration of a rotor spinning at constant angular velocity are described The equations of motion are derived using an assumed modes expansion. A computer code is described which implements the theory. The input and output for a sample problem are included.

CRYOGENIC AND SUPERCONDUCTING EQUIPMENT AND DEVICES

REFER ALSO TO CITATION(S) 20593, 20595, 20867, 21508, 21509

21010 (AD-A—072712) **Analysis of superconducting electric machines for Naval ship propulsion. Master's thesis.** St. John, L.G. (Naval Postgraduate School, Monterey, CA (USA)). May 1978. 184p. NTIS, PC A09/MF A01.

A proposed ship propulsion system which incorporates superconducting electric machines as the transmission system between the prime mover and the propeller is described. The propulsion system employs gas turbine prime movers, synchronous generators and synchronous motors with superconducting field windings, switch gear with a cycloconverter, variable frequency, power controller between the generators and the motors. The proposed system is the DD963 destroyer, which has a gas turbine propulsion system driving controllable pitch propellers through reduction gears. The resulting ship is compared with the original on the basis of weight and volume. The proposed superconducting motors and generators are modeled mathematically and simulated on a digital computer. Components for the motors and generators are designed to determine their individual characteristics and their interactions with other elements of the machines. Design analysis of the superconducting machines indicates they will be very small and lightweight.

21011 (SAND—80-0173) **Generation and propagation of large-area electron beams.** Poukey, J.W. (Sandia Labs., Albuquerque, NM (USA)). Jan 1980. Contract EY-76-C-04-0789. 22p. Dep. NTIS, PC A02/MF A01.

Two-dimensional particle codes and analytic methods are used to study large cross-section relativistic electron beam production and subsequent propagation in gas. To obtain a beam suitable for laser applications, i.e., only slight magnetic pinching, it is found that one requires an applied magnetic field which is about the same as, or exceeds, the self field.

PROTECTIVE STRUCTURES AND EQUIPMENT

21012 (CONF-791103—91) **Scale system cross section validation with shipping-cask critical experiments.** Westfall, R.M.; Knight, J.R. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 7p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

Results are presented of 70 critical experiments simulating LWR fuel element shipping casks and storage pools. Four series of experiments were analyzed: 2.35% enriched UO_2 rods at a lattice pitch of 2.032 cm, 4.29 % enriched rods at 2.54 cm pitch, and these lattices positioned between simulated Pb and depleted U shields. Results show that each of the three libraries (ENDF/B-IV, GAM-THERMOS, Hansen-Roach) is adequate. 2 tables. (DLC)

HANDLING EQUIPMENT AND PROCEDURES

REFER ALSO TO CITATION(S) 20114, 20143, 21012, 21328

21013 (CONF-791103—78) **Methods development for criticality safety analysis.** Westfall, R.M. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 6p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

A status review on the work at Oak Ridge to develop improved methods for performing multigroup, discrete-ordinates, and Monte Carlo criticality safety analyses is presented. In the area of multigroup cross section preparation this work entails the testing

of ENDE/B-IV based and other cross-section libraries in the SCALE system, the development of improved cross-section processing methods for the AMPX system, and the generation of an ENDF/B-V based library. In the area of systems analysis this work entails improvements to the one-dimensional discrete-ordinates code XSDRNPM-S, the testing of the combinatorial geometry version of KENO, KENO-IV/CG, and development of an advanced version of KENO, KENO-V. Also presented is a brief review of the existing criticality safety analytical sequences in the SCALE system, CSAS1 and CSAS2, and the development of the advanced analytical sequences CSAS3 and CSAS4.

21014 (CONF-791103—84) **Improved criticality search techniques for low and high enriched systems.** Lorek, M.J.; Dodds, H.L.; Petrie, L.M.; Westfall, R.M. (Tennessee Univ., Knoxville (USA); Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 7p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

A new automated search technique has been developed to improve the computational efficiency of performing criticality searches on low and high enriched systems with codes such as ANISN and KENO-IV. The technique employs a least-squares fit to a cubic polynomial on parameter values that have been previously generated either by the Extended Mean Value Theorem (EMVT) or by previous curve fits. The solution of the cubic for its roots at the desired value of K-effective completes one pass for the fixed value search while the solution of its derivative provides information about maximum values. This new search technique has been implemented in a FORTRAN routine called OPTMIZ which will eventually be part of a module in the SCALE system.

21015 (CONF-791103—87) **Reactivity effect of cross-section processing for moist bulk-oxide criticals.** Bucholz, J.A.; Westfall, R.M. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 7p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

Good multigroup cross-section data is necessary if accurate analyses of critical or slightly sub-critical systems are performed. How the flux spectrum as calculated by the Nordheim method and by a more exact method can ultimately affect the calculated multiplication and/or critical mass of slightly moderated bulk-oxide systems is shown. Self-shielded multigroup cross sections were generated using the Nordheim method as implemented in the NITAWL code and by a more exact method as implemented in the ROLAIDS code. To eliminate geometric effects, both codes were used to generate cross sections for an infinite homogeneous media of U_3O_8 and water (U = 4.65% Uranium 235).

21016 (CONF-791103—90) **Rigid hoist articulated grapple system development for enhanced remote maintenance.** Witham, C.; White, P.; Garin, J. (MB Associates, San Ramon, CA (USA); Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 24p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

Remote maintenance and repair within nuclear environments have become more demanding of remote manipulation equipment in the last few years. A deficiency exists in the array of tools available for dexterous operations of loads in the 180-kg range. The development of a manipulation system with enhanced operator controls is discussed. This system is a six-degree-of-freedom manipulator with bilateral servo control. It is to be attached to a mobile support boom in order to operate throughout the nuclear cell. The manipulator is intended to work in conjunction with light duty servomanipulators, overhead crane systems, and through-the-wall mechanical master slaves.

21017 (CONF-800431—4) **Four critical facilities: their capabilities and programs.** Whitesides, G.E. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 11p. Dep. NTIS, PC A02/MF A01.

From Nuclear criticality safety topical meeting; El Paso, TX, USA (8 Apr 1980).

Information is presented on the critical experiments facilities at Babcock and Wilcox, Lynchburg, Virginia; at Battelle Pacific Northwest Laboratory in Hanford, Washington; at Rockwell-International in Rocky Flats, Colorado; and at Los Alamos Scientific Laboratory in New Mexico. It is noted that the critical mass facilities which still exist in this country represent a bare minimum for maintaining a measurement program sufficient for meeting data requirements.

21018 (CONF-800431—5) **Influence of safeguards and fire protection on criticality safety.** Six, D.E. (Idaho National Engineering Lab., Idaho Falls (USA)). 1980. Contract EY-76-C-07-1570. 23p. Dep. NTIS, PC A02/MF A01.

From Nuclear criticality safety topical meeting; El Paso, TX, USA (8 Apr 1980).

There are several positive influences of safeguards and fire protection on criticality safety. Experts in each discipline must be aware of regulations and requirements of the others and work together to ensure a fault-tree design. EG and G Idaho, Inc., routinely uses an Occupancy-Use Readiness Manual to consider all aspects of criticality safety, fire protection, and safeguards. The use of the analytical tree is described.

21019 (UCRL—52786) **Seismic safety of the LLL plutonium facility (Building 332).** Torkarz, F.J.; Shaw, G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Jan 1980. Contract W-7405-ENG-48. 68p. Dep. NTIS, PC A04/MF A01.

This report states the basis for the Lawrence Livermore Laboratory's assurance to the public that the plutonium operations at the Laboratory pose essentially no risk to anyone's health or safety, either under normal circumstances or in the event of an earthquake or a fire. The report is intended for a general audience, and so for the most part it is not highly technical. It summarizes the steps taken to ensure the seismic safety of the plutonium facility (Bldg. 332). It describes plutonium and its potential hazard and how the facility copes with that hazard. It recounts the geologic investigations and interpretations that led to the design-basis earthquake (DBE) for the Livermore site, and presents a summary analysis of the facility structure in relation to the DBE. An appendix presents a quantitative calculation of the health risk to the public associated with the worst-case hypothetical fire. The document supports the conclusions that the facility will continue to function safely after the maximum earthquake ground motion to which it may be subjected and that there is no evidence of a potential for surface offset under it.

SHIPPING CONTAINERS

21020 (SAND—78-1121C) **Crashworthy sealed pressure vessel for plutonium transport.** Andersen, J.A. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 35p. (CONF-800513—1). Dep. NTIS, PC A03/MF A01.

From 4. international conference on pressure vessel technology; London, UK (19 May 1980).

A rugged transportation package for the air shipment of radioisotopic materials was recently developed. This package includes a tough, sealed, stainless steel inner containment vessel of 1460 cc capacity. This vessel, intended for a mass load of up to 2 Kg PuO_2 in various isotopic forms (not to exceed 25 watts thermal activity), has a positive closure design consisting of a recessed, shouldered lid fastened to the vessel body by twelve stainless-steel bolts; sealing is accomplished by a ductile copper gasket in conjunction with knife-edge sealing beads on both the body and lid. Follow-on applications of this seal in newer, smaller packages for international air shipments of plutonium safeguards samples, and in newer, more optimized packages for greater payload and improved efficiency and utility, are briefly presented.

TRANSPORT AND STORAGE FACILITIES

REFER ALSO TO CITATION(S) 20811

21021 (CONF-790749—, pp 192-232) **Problems associated with diesel engines operating on fuel oil of poor quality.** Wiborg, T.C. (Det norske Veritas, Hoevik, Norway). Dec 1979.

From Conference on advanced materials for alternate fuel capable directly fired heat engines; Castine, ME, USA (30 Jul 1979).

There is a continuous struggle to find methods to obtain economical operation of ships. The prospect of global energy shortage has its impact on the price and quality of fuels offered to the marine market. With freight as low as they are today and profits and expenses often near the break even point, fuel economy is a major concern. The cheapest fuel is, in general terms, the one which offers the greatest threat to engine reliability. The quality of heavy fuel oil, however, varies widely depending on which refinery process and type of crude oil it is derived from. The specifications according to which it is ordered are rather few and are almost completely irrelevant for the quality of the product. Our knowledge as to which are the relevant criteria to use when evaluating the combustion quality of a fuel is limited. Therefore, research work has been, and is being, carried out by our institution in cooperation with others. The aim of this work is to determine which fuel properties are important, how these properties may be measured, how incipient trouble caused by poor combustion may be detected, and how the harmful effects may be counteracted.

21022 (CONF-790749—, pp 233-257) **Ceramic coatings on diesel engine components.** Kvernes, I.; Solberg, J.K.; Lillerud, K.P. (Central Inst. for Industrial Research, Olso, Norway). Dec 1979.

From Conference on advanced materials for alternate fuel capable directly fired heat engines; Castine, ME, USA (30 Jul 1979).

Today there are, broadly speaking, three categories of heavy fuels on the market. These are: residue from straight run distillation, residue from vacuum distillation and visbraking, and residue from the cracking process. The two latter oils have the highest carbon content because the hydrogen enriched compounds have been removed with the light fractions; the last may in addition contain powder of Al_2O_3, SiO_2 or Ni from the catalysts. The problems involved in economic operation of diesel engines arise mostly in connection with combustion, corrosion, formation of deposits on the surface, etc. The most common oil parameters (standard analysis) give an indication of the corrosive components, but limited information concerning the combustion problems. Low quality combustion will for instance affect: fuel economy, exhaust gas emissions, thermal loading, wear, fouling, and corrosion. By burning heavy oil, inorganic ashes and soot will be formed together with CO_2, H_2O and SO_2 gases. The ashes originate from metal organic constituents and pollutions in the oil. Differences in soot quality can be traced back to variations in heavily decomposed C/H-groups. The main components bonding (2). Some components burn badly and some very well, some need high temperature before ignition, and some do not ignite The body of the report deals with the thermal isolation of the combustion chamber by ceramic coatings, eg. zirconium oxide. The idea is that reduction level losses may reduce fuel oil consumption up to 2%. The stability and adhesion of the coatings are discerned as well as their degradation by corrosion or thermal fatigue. (LTN)

LASERS

REFER ALSO TO CITATION(S) 21379, 21534

21023 (AD-A—071714) **Lasers, a bibliography. Final report.** Miller, L.L. Jr. (Army Field Artillery School, Fort Sill, OK (USA)). 2 Sep 1979. 10p. NTIS PC A02/MF A01.

The subject of laser technology as applied to theory and military practice is covered in this bibliography. Materials have been selected from the unclassified holdings of the Morris Swett library. Book and periodical articles are covered.

21024 (AD-A—071912) **Ten point six micron laser target designator. Final report, 15 November 1975-31 March 1978.** Rudko, R.I. (Raytheon Co., Wayland, MA (USA). Advanced Development Lab.). Nov 1978. Contract DAAB07-76-C-0830. 41p. NTIS PC A03/MF A01.

A research version of a 10.6 micron laser designator was constructed. The device weighs 26 lbs without power supply. Output energy of 100 mJ in 30 nsec pulses at 2 - 20 pulses per second with a 1.5 percent overall efficiency were achieved.

21025 (AD-A—072601) **Laser irradiance in the sea: theory and experiment. Technical research report.** Bobb, L.C.; Ferguson, G.; Rankin, M. (Naval Air Development Center, Warminster, PA (USA). Sensors and Avionics Technology Directorate). Sep 1978. 44p. NTIS PC A03/MF A01.

Laser beam spreading due to the air/sea interface, volume scattering, and initial beam divergence is modeled. Beam steering is considered for the case in which the laser beam diameter is small compared to the length of the refracting wave. An expression is developed for the irradiance as a function of depth into the ocean. A comparison of the terms in this expression shows that the surface spreading effect is small compared with bulk scattering. Wavetank experiments were performed. The height, slope, and frequency content of wind-driven capillary waves are reported for wind speeds in the range 2.2 m/sec to 7.6 m/sec.

21026 (AD-A—072704) **Laser pump lamps. Final report Feb 1976-Sep 1978.** Anderson, N.C. (ILC Technology, Inc., Sunnyvale, CA (USA)). Feb 1979. Contract F33615-76-C-1029. 152p. NTIS, PC A08/MF A01.

The subject program was undertaken to develop technology for producing a potassium vapor arc lamp with a 3000 hour lifetime. The lamp is to be used as optical pump source in a Nd:YAG laser transmitter as part of a space communications system. The lamp lifetime goal was successfully achieved, a characteristic lifetime of approximately 6000 hours being demonstrated for lamps built late in the program. In addition, the final lamp satisfied virtually all other design and performance requirements. Most of the effort on the program was directed at developing supporting technology for the lamp. This work included solving problems of basal plane cracking and potassium vapor attack of the sapphire envelope, developing a long-lived cathode, determining the most efficient lamp fill, developing an oxidation protection coating for the Kovar endcaps, optimizing the Kovar-to-sapphire brazed seal design, conducting thermal design proof tests (including simulation of zero-g effects), improving the potassium filling procedure, developing an optimized lamp operating procedure, and conducting vibration tests.

21027 (AD-A—073140) **Research studies on neodymium pentaphosphate miniature lasers. Final report 1 Oct 1977-30 Sep 1978.** Chinn, S.R. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 30 Sep 1978. Contract F19628-78-C-0002. 60p. NTIS, PC A04/MF A01.

The thermal conductivity and specific heat of NdP_5O_{14} have been measured using a dynamic electrical heating technique. The values of the thermal conductivity tensor elements (in W/cm-K) are Lambda sub a = .021, Lambda sub b = .00966, and Lambda sub c = .014. The specific heat is 0.141 cal/g-K, in excellent agreement with the value of 0.139 cal/g-K that was measured by differential scanning calorimetry. We have calculated the time-dependent heating effects of typical flash-lamp-excited round and rectangular laser rods. With repetition rates limited to approx. 10 ppm, simple conductive cooling by an ambient-temperature heat-sink should be adequate. Computer simulation of the flash-lamp-excited NPP laser has been carried out by numerical solution of the laser rate equations. With 1 J electrical input, typical calculated output energies are 24 mJ for normal-mode operation and 10 mJ for passively Q-switched operation. Optimum Q-switch absorption and output mirror transmission have also been calculated. Experimental studies of such lasers have been made with varying laser rod size and laser resonator parameters.

21028 (DOE/ER/10350—1) **Tunable, narrow bandwidth 83 nm light source.** Egger, H.; Hawkins, R.T.; Bokor, J.; Pummer, H.; Rothschild, M.; Rhodes, C.K. (Illinois Univ., Chicago (USA). Dept. of Physics). 1980. Contract EY-76-C-02-1198. 4p. (CONF-800614—1). Dep. NTIS, PC A02/MF A01.

From 11. international quantum electronics conference; Boston, MA, USA (23 Jun 1980).

Up to 40 MW (peak power) of coherent, tunable xuv light, with a bandwidth $< 10^{-2}$ cm^{-1} and absolute frequency control to within 4×10^{-2} cm^{-1}, has been generated by frequency tripling of a narrow bandwidth KrF laser in xenon.

21029 (PB—80-101256) **Design of a reflection apparatus for laser beam profile measurements.** Johnson, E.G. Jr. (National Bureau of Standards, Boulder, CO (USA)). Jul 1979. Contract CCG-78-109. 122p. NTIS, PC A06/MF A01.

Measurement of both the irradiance and phase front (the beam profile) in real time from the output of a laser has interest for control of that beam and for efficient energy and economic design of the source and the resulting optical systems. The National Bureau of Standards has begun a program to build a unit that can measure, at numerous wavelengths from 1.06 micrometers to 10.6 micrometers, a selected spatial sample of the beam profile. The design analysis reported here includes: the theory which uses Fourier optics concepts with off-axis reflections and rough surfaces to provide the basis for accurate computer simulation of laser beams; the program, BEAM, which generates the expected behavior of the apparatus under variation of laser wavelength, physical dimensions for curvatures, hologram structure, and changes in positions of the various components; the simulation results which demonstrate the expected characteristics for the apparatus; and the key element in the apparatus, namely the reflection hologram, which requires discussion of the design, construction, and testing of this element. The Hartmann plate method is described briefly so that a comparison between it and the holographic method can be made. The comparison shows why the holographic method is best for a standard for irradiance and phase-front measurements.

21030 **Cyano compounds as fuels for HF or DF lasers.** Martignoni, P.; Murfree, J.A. Jr.; Chew, W.M.; Ayers, O.E. US Patent 4,102,988. 25 Jul 1978. Filed date 3 Oct 1977. 7p.

A cyano compound fuel selected from the group consisting of dicyanoacetylene (DCA), tetracyanoethylene (TCE), and tetracyanoethylene oxide (TCEO) when reacted with an oxidizer compound selected from the group consisting of fluorine (F_2), nitrogen trifluoride (NF_3), chlorine trifluoride (ClF_3), chlorine pentafluoride (ClF_5), and tetrafluorohydrazine (N_2F_4) produces the F atom concentration required for either HF or DF lasers. The reaction is accomplished in the presence of a diluent gas selected from nitrogen and helium. No deactivation species are among the gaseous species produced which include CF_4, F atoms, and N_2; therefore, deactivation of the excited molecules, either HF or DF, which are responsible for the lasing in a HF or DF laser is prevented. A higher performance of the laser device can be achieved.

21031 **Frequency stable boron nitride channel laser.** Papayoanou, A. US Patent 4,129,836. 12 Dec 1978. Filed date 4 Apr 1977. 8p.

This patent discloses a CW waveguide channel gas laser constructed from boron nitride which, due to its high thermal conductivity and extremely low thermal expansivity, provides increased frequency stability.

21032 **Gain spike and mode control for spiked lasers.** Cason, C.M. III. US Patent 4,127,826. 28 Nov 1978. Filed date 13 May 1977. 5p.

This patent discloses a laser system using a cw HeNe laser for transmitting a beam through a dichroic into an unstable resonator. A second laser, a cw CO_2 laser, has its beam transmitted through the dichroic to follow the HeNe beam into the unstable resonator laser aperture. The resonator's secondary and primary mirrors are adjusted into a parallel orientation which gives a series of circles in both laser beams. The gain-spike is suppressed to eliminate air breakdown.

HEAT TRANSFER AND FLUID FLOW

REFER ALSO TO CITATION(S) 20778, 21005, 21006

21033 (DOE/ER/10439—1) **Chemical reaction and turbulence. Progress report, June 1, 1979-May 31, 1980.** Chevray, R. (State Univ. of New York, Stony Brook (USA)). Feb 1980. Contract AC02-79ER10439. 16p. Dep. NTIS, PC A02/MF A01.

This corresponds to the first year of our investigation into the interaction of chemical reactions and turbulence. During this time, construction of a special purpose wind tunnel was completed, the fiber optics probe for concentration measurements was designed and constructed, and the general method of attack on the theoretical front was set up by first looking at the problem of total dispersion of a scalar in turbulent flows and independently setting up a scheme to model directly the equations describing the evolution of the probability density function of the species concentrations in the free shear layer. All the aforementioned tasks were performed on schedule according to the time chart originally proposed.

21034 (KAPL—4124) **Flow-induced tones in side-branch pipe resonators.** Pollack, M.L. (Knolls Atomic Power Lab., Schenectady, NY (USA)). Oct 1979. Contract EY-76-C-12-0052. 19p. (CONF-800405—1). Dep. NTIS, PC A02/MF A01.

From Acoustical Society of America conference; Atlanta, GA, USA (21 Apr 1980).

Acoustic tones generated by turbulent flows and shear-layer-instability interactions with side-branch resonator pipes were investigated experimentally using Fast Fourier Transform techniques. The experimental values of resonant frequencies and instability frequencies were compared with predictions for two stages of shear-layer interaction. Relative tonal amplitudes are shown to demonstrate cut-in and cut-out phenomena. The qualitative differences between turbulent-flow-generated tones and instability-generated tones are also noted.

21035 (LA-UR—79-2606) **Possible departures from local isotropy in the small scale structure of turbulent velocity fields.** Mjolsness, R.C. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 24p. (CONF-800702—1). Dep. NTIS, PC A02/MF A01.

From 2. international symposium on turbulent shear flows; London, UK (2 Jul 1980).

Two weakened similarity hypotheses are proposed as possible replacements for the two Kolmogorov similarity hypotheses as descriptions of laboratory turbulence. It is shown that these hypotheses yield consequences which are in full agreement with the whole range of laboratory, atmospheric, and oceanic measurements bearing on the question of the existence of local isotropy in turbulent flows. However, the weakened hypotheses are fully consistent with the non-existence of local isotropy. It is concluded that a new class of measurements - the measurement of cross-stream variations in the velocity correlations - would be required to establish the existence or non-existence of local isotropy. One consequence of the proposed weakened similarity hypotheses is that the Kolmogorov constant C is not a constant, but is, instead, a flow-dependent quantity, depending on velocity gradients. This is in at least qualitative agreement with the large scatter in values of C reported in the literature.

21036 (PB—298881) **Liquid metal boiling in the presence of a magnetic field. Master's thesis.** Wagner, L.Y. (Purdue Univ., Lafayette, IN (USA). Dept. of Nuclear and Chemical Engineering). May 1975. 126p. NTIS PC A07/MF A01.

In an analysis of the effects of a magnetic field on liquid metal boiling, based on bubble growth dynamics, heat transfer controlled growth as well as the influence of liquid inertia forces are considered. Under the influence of the magnetic field for the asymptotic heat transfer controlled growth stage, the radial growth rate is proportional to time, but the bubble size is reduced. These effects are more significant with alkali metals than with mercury, and for increasing superheats. Since similar trends were noted when the liquid inertia effects were included in the analysis, it was concluded that the heat transfer controlled solution is adequate to describe bubble growth for high magnetic fields (50 kG) at low superheats for mercury, and at both high (30 degrees C) and low superheats for potassium. In all other cases, the liquid inertia contributes significantly to bubble growth. A heat transfer model formulated from a forced convection approach indicated a significant reduction of boiling rate for both liquid metals when the magnetic field is applied although effects in potassium are greater.

21037 (UCID—17980(Rev.1)) **TACO: a finite element heat transfer code.** Mason, W.E. Jr. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Feb 1980. Contract W-7405-ENG-48. 80p. Dep. NTIS, PC A05/MF A01.

TACO is a two-dimensional implicit finite element code for heat transfer analysis. It can perform both linear and nonlinear analyses and can be used to solve either transient or steady state problems. Either plane or axisymmetric geometries can be analyzed. TACO has the capability to handle time or temperature dependent material properties and materials may be either isotropic or orthotropic. A variety of time and temperature dependent loadings and boundary conditions are available including temperature, flux, convection, and radiation boundary conditions and internal heat generation. Additionally, TACO has some specialized features such as internal surface conditions (e.g., contact resistance), bulk nodes, enclosure radiation with view factor calculations, and chemical reactive kinetics. A user subprogram feature allows for any type of functional representation of any independent variable. A bandwidth and profile minimization option is also available in the code. Graphical representation of data generated by TACO is provided by a companion post-processor named POSTACO. The theory on which TACO is based is outlined, the capabilities of the code are explained, the input data required to perform an analysis with TACO are described. Some simple examples are provided to illustrate the use of the code.

21038 (UCRL—82842) **New finite element for Boussinesq fluids.** Gresho, P.M.; Lee, R.L.; Chan, S.T.; Leone, J.M. Jr. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Sep 1979. Contract W-7405-ENG-48. 14p. (CONF-800613—1). Dep. NTIS, PC A02/MF A01.

From 3. international conference on finite element in flow problems; Banff, Alberta, Canada (10 Jun 1980).

A new finite element is described and demonstrated. It is shown to be a better element than that from which it was derived and that it is simple to add to existing codes. However, it is also shown that the new element is still not as good as one containing the optimum constraint ratio (which is also described and demonstrated).

21039 (UCRL—82867) **On the spurious pressures generated by certain GFEM solutions of the incompressible Navier-Stokes equations.** Sani, R.L.; Gresho, P.M.; Lee, R.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Oct 1979. Contract W-7405-ENG-48. 15p. (CONF-800613—4). Dep. NTIS, PC A02/MF A01.

From 3. international conference on finite element in flow problems; Banff, Alberta, Canada (10 Jun 1980).

The spurious pressures and acceptable velocities generated when using certain combinations of velocity and pressure approximations in a Galerkin finite element discretization of the primitive variable form of the incompressible Navier-Stokes equations are analyzed both theoretically and numerically for grids composed of quadrilateral finite elements. Schemes for obtaining usable pressure fields from the spurious numerical results are presented for certain cases.

21040 (UCRL—82868) **Comparison of several conservative forms for finite element formulations of the incompressible Navier-Stokes or Boussinesq equations.** Lee, R.L.; Gresho, P.M.; Chan, S.T.; Sani, R.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Oct 1979. Contract W-7405-ENG-48. 12p. (CONF-800613—2). Dep. NTIS, PC A02/MF A01.

From 3. international conference on finite element in flow problems; Banff, Alberta, Canada (10 Jun 1980).

Why the advective form for the primitive variable formulation of the inviscid Boussinesq (or Navier-Stokes) equations is nonconservative and how several potentially useful conservative formulations can be generated is demonstrated. Several forms are considered which conserve the following quantities individually or in combinations: total energy, temperature (enthalpy), temperature squared, or none of the above (advective form). Finally the numerical performance and stability of these various formulations are compared via numerical solutions of the time-dependent, inviscid equations of motion employing the finite element method.

MATERIALS TESTING

REFER ALSO TO CITATION(S) 20870, 20907, 21096, 21103

ELECTRONIC CIRCUITS AND DEVICES

REFER ALSO TO CITATION(S) 20316

21041 (BDX—613-2323) **Reliability studies of metallization procedures for Kovar lead frames.** Vaughn, J.G. (Bendix Corp., Kansas City, MO (USA)). 15 Jan 1980. Contract EY-76-C-04-0613. 22p. (CONF-800118—3). Dep. NTIS, PC A02/MF A01.

From 2. AES design and finishing of printed wiring and hybrid circuits symposium; San Francisco, CA, USA (15 Jan 1980).

Five metallization procedures were evaluated to determine a manufacturing process that would produce the most solderable and reliable Kovar lead frame package. From the metallization procedures examined, it was determined that: (1) silver-copper brazes lead to liquid-metal embrittlement of the metallized Kovar; (2) nickel electroplating of the Kovar reduces, but does not eliminate, copper penetration from the silver-copper braze; (3) low cobalt-nickel electrodeposits appear to be a better diffusion barrier than high cobalt-nickel compositions: (4) nickel electroplating of the Kovar lead increases nickel contamination on the gold surface; and (5) gold plating uniformity and porosity are of major concern in lead frame processing.

21042 (SAND—79-1884) **User/programmer guide for UCMD86: hybrid microcircuit hole table.** Parks, R.E. (Sandia Labs., Albuquerque, NM (USA)). Mar 1980. Contract EY-76-C-04-0789. 15p. Dep. NTIS, PC A02/MF A01.

This document describes program UCMD86 - an Applicon AGS/870 User Command for the generation of hybrid microcircuit hole tables, on the detail level (9) for all hole cells selected at the time of execution. 3 figures.

21043 (UCRL—83675) **Electronics Engineer's Design Station.** Bering, D.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 Dec 1979. Contract W-7405-ENG-48. 21p. (CONF-800622—1). Dep. NTIS, PC A02/MF A01.

From 17. design automation conference; Minneapolis, MN, USA (23 Jun 1980).

A prototype minicomputer interactive graphics system which has been developed for the capture, formatting and dissemination of electronics design information is described. The principle function of this system is to bring unification to the Design Automation activities at LLL, while incorporating human factors and modern tools into the electronics design process. The Electronics Engineer's Design Station (hereafter referred to as the Design Station) is a minicomputer based system at which LLL's engineers and designers sketch in schematic designs. Once a circuit is formed at the graphics display, the pertinent design information is extracted and used to produce schematic drawings, parts, lists, signal lists, parts and signal cross references and assembly drawings as well as inputs to simulators, automated layout tools and fabrication devices. Current fabrication technologies supported include both wirewrap and printed circuit methodologies. This system is designed to expedite the low volume, fast turnaround electronics designs which are typical of LLL's research projects. However, many of the concepts of this system address problems common throughout the electronics industry.

WASTE PROCESSING PLANTS AND EQUIPMENT

REFER ALSO TO CITATION(S) 20826

COMBUSTION SYSTEMS

REFER ALSO TO CITATION(S) 19903, 19954, 19983, 20019, 20020, 20021, 20024, 20027, 20028, 20029, 20030, 20032, 20033, 20035, 20068, 20827

21044 (CONF-790749—, pp 887-912) **Erosion/corrosion of small superalloy turbine rotors operating in the effluent of a PFB coal combustor.** Zellars, G.R.; Benford, S.M.; Rowe, A.P.; Lowell, C.E. (Lewis Research Center, Cleveland, OH). Dec 1979.

From Conference on advanced materials for alternate fuel capable directly fired heat engines; Castine, ME, USA (30 Jul 1979).

Integrally cast Alloy 713LC and IN792 + Hf superalloy turbine rotors in a single stage turbine with 6% partial admittance have been operated in the effluent of a pressurized fluidized bed coal combustor for up to 164 hours. Total mass flow was 300 kg/hr and average particulate loadings ranged from 600 to 2800 ppM for several coal/sorbent combinations. A 5.5 atm turbine inlet gas pressure and inlet gas temperatures from 700 to 800°C yielded absolute gas velocities at the stator exit of about 500 m/s. The angular rotation speed (40,000 RPM) of the 6-inch diameter rotors was equivalent to a tip speed of about 300 m/s, and average gas velocities relative to the rotating surface ranged from 260 to 330 m/s at mean radius. The rotor erosion pattern reflects heavy particle separation with severe (5 to 500 cm/yr) erosion at the leading edge, pressure side center, and suction side trailing edge at the tip. The erosion distribution pattern provides a spectrum of erosion/oxidation/deposition as a function of blade position. This spectrum includes enhanced oxidation (10 to 100 x air), mixed oxides in exposed depletion zones, sulfur rich oxides in deposition zones, and rugged areas of erosive oxide removal. Although particle separation and erosive damage will be much less severe in large turbines operated at lower paticulate levels, these data suggest that preferential degradation paths may exist even under the targeted lower loadings (<200 ppM) because of the diversity of potential erosion/corrosion interactions along erosion paths.

21045 (CONF-790749—, pp 913-938) **Fluidized bed experience at Curtiss-Wright.** Moskowitz, S.; Mogul, J.; Wolosin, S. (Curtiss-Wright Corp., Wood-Ridge, NJ). Dec 1979.

From Conference on advanced materials for alternate fuel capable directly fired heat engines; Castine, ME, USA (30 Jul 1979).

Fluidized bed coal combustion is an application which uses the fluidized bed as a medium in which to burn coal. It is characterized by high combustion efficiency, as well as high heat transfer and heat release rates. British and then American researchers investigated fluidized bed coal combustion in the late 1950's and 1960's. Both established the important fact that calcium containing materials, such a limestone and dolomite, react chemically within the combustor, in a narrow temperature range (1550 to 1750°F) to capture the sulfur in the coal forming solid calcium sulfate. These investigators were also intrigued with the idea of pressurizing the fluidized bed coal combustor and feeding the hot, pressurized combustion gases into a gas turbine. The turbine would produce electric power as well as supplying the pressurized air for fluidiziation and combustion in a bed of coal and dolomite. Gas turbine electric power generating plants can be constructed at lower initial costs and with shorter lead times than conventional coal fired steam plants or nuclear power plants. By installing a boiler in the gas turbine exhaust, to produce steam for a steam turbine/electric generator, an increase in overall plant efficiency is obtained. Such combined cycle plants now operate on clean petroleum and gaseous fuel. The challenge is to integrate a pressurized fluidized bed coal combustor into the combined cycle system, in place of the liquid or gas combustor. In addition to a higher overall efficiency than conventional coal plants equipped with stack gas scrubbers, this system promises: control of sulfur oxide emissions during combustion due to the in-bed sulfur sorbent; low nitrogen oxide emission due to moderate combustion temperatures, and; low particulate emissions with an effective hot gas clean up train. Curtiss-Wright's program and experience are described.

21046 (CONF-790749—, pp 939-956) **Degradation of high temperture materials in a test cascade exposed to a high velocity PFBC efflux.** McCarron, R.L.; Beltran, A.M.; Grey, D.A. (General Electric Co., Schenectady, NY). Dec 1979.

From Conference on advanced materials for alternate fuel capable directly fired heat engines; Castine, ME, USA (30 Jul 1979).

The results are summarized: successful operation of a PFBC/turbine test section has been accomplished for a period of 783 hours. Measurements of alkali concentrations in the PFBC combustion products confirm thermodynamic predictions and show the alkali level to be 2 to 3 ppM in the exhaust gas. Measured paticulate loadings were typically between 0.02 to 0.04 grains/scf during the first 565 hours of exposure which resulted in little erosion of leading edges. Short excursions to approximately 0.46 grains/scf resulted in significant erosion of leading edges in just 5 to 6 hours of operation. Protective coatings/claddings are required for adequate corrosion life as base superalloys suffer considerable sulfidation in short periods of time. In-671 is not recommended for use in PFBC environments at 1550°F as it is totally destroyed (0.010 inch) in less than 565 hours.

21047 (CONF-800428—1) **Atmospheric fluidized-bed combustion coal feeding test program.** Daw, C.S.; Thomas, J.F.; Holcomb, R.S.; Andrews, C.K. (Oak Ridge National Lab., TN (USA); Tennessee Valley Authority, Chattanooga (USA)). 1980. Contract W-7405-ENG-26. 15p. Dep. NTIS, PC A02/MF A01.

From 6. international conference on fluidized bed combustion; Atlanta, GA, USA (9 Apr 1980).

Development of a coal feeding and distribution system is one of the major requirements for successful operation of large scale atmospheric fluidized-bed boilers. Since combustion efficiency, sulfur capture, and tube corrosion are strong functions of coal distribution in the bed, the reliability of the feed system is critical. One proposed coal feeding method involves underbed feed nozzles, and pneumatic conveying is a key element in this method. Several technical problems are inherent in such systems. One program aimed at resolving these problems involves testing a pneumatic transport system constructed to represent the branch feed lines in TVA's 20 MW AFBC pilot plant. The major objective is to determine the practical limits of such operating parameters as surface moisture, transport velocity, and coal loading. In addition, correlations are being developed to predict line pressure drop as a function of the conveying parameters. Pressure drop is important because it determines the feed system pumping costs and is a good indicator of

changes in the solids flow regime. Preliminary results indicate that surface moisture is the most important factor in getting coal into the transport line. Coal with up to 6 wt % surface moisture can be fed with little difficulty, but higher moisture results in severe bridging and compaction in the feed hopper and feeder mechanism. Once the coal is in the transport line, moisture level does not appear to be as important. It has also been found that within the range of particle sizes studied, the percentage of fines has little effect. In fact, as long as saltation is not occurring, the conveying characteristics of a coal-air mixture seem to depend primarily on coal loading. In general, saltation and plugging will not occur as long as superficial air velocity is above 12.2 m/sec (~ 40 ft/sec).

21048 (FE—1237/Q-79/16) **Multicell fluidized bed boiler design, construction and test program. Quarterly progress status report, July-September 1979.** (Pope, Evans and Robbins, Inc., New York (USA)). Dec 1979. Contract EX-76-C-01-1237. 51p. Dep. NTIS, PC A04/MF A01.

Several milestones were achieved relative to operation of the Rivesville MFB including extended operation of C cell alone, longest continuous commercial operational determination of optimum conditions for C and B cells; and successful operation in the fly ash reinjection mode. During periods of MFB operation, newly installed equipment was checked out in long duration runs at steady state conditions. An outage brought on by the need for Monongahela Power Company to conduct maintenance and repairs to their boiler and turbine generator, provided the opportunity to accomplish certain work on the MFB unit. This included: installation of the Fuller-Kinyon fuel feed system for C cell, new air distributors for C and B cells, installation of additional valves and routine maintenance. Several baghouse filter tests were carried out. The New York Office design and engineering staff continued to perform various tasks in support of continued operation of the MFB boiler plant and improvements for increased reliability.

21049 (FE—2473-34) **Industrial application of fluidized-bed combustion. Phases I and II. Quarterly technical progress report, July-September 1979.** (Combustion Engineering, Inc., Windsor, CT (USA)). 1979. Contract EX-76-C-01-2473. 19p. Dep. NTIS, PC A02/MF A01.

Analysis and evaluation of Sub-Scale Unit operational and test data has not shown any cause to expect unsuccessful operation of the Demonstration Plant. Major changes to the Demonstration Plant based on the SSU results significantly improve the prospect for a smooth shakedown and startup of the plant. Modification of in-bed heat transfer to compensate for changes in the design heat transfer rates and heat release distribution has been accomplished. Provisions to vary reinjection rates during operation over the range of 0 to 90 percent maximum expected flow rates and control dust loadings have been added. Redesign of the bed air distribution (grid plates), allowing for free thermal expansion, has been included. Improvements to the design of instrumentation probes to provide reliable sensing for control valves were provided. In addition, the operation of the SSU has verified that the fluidized bed combustion process as designed for the Demonstration Plant should achieve the required performance. All major components of the Demonstration Plant have been specified. Fabrication releases have been issued for critical items. The design phase of the project is near 95% completion. Construction is well underway. Concrete work is more than 90% complete. Structural steel erection has started, as well as silo fabrication. The facility should be enclosed with roofing and siding before the arrival of severe winter weather. A test program has been prepared and submitted to DOE. Arrangements are being made for operational manpower and test equipment.

21050 (PB—80-102007) **Angular flow insensitive pitot tube suitable for use with standard stack testing equipment. Final report.** Mitchell, W.J.; Blagun, B.E.; Johnson, D.E.; Midgett, M.R. (Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab.). Jun 1979. 88p. NTIS, PC A05/MF A01.

Five pitot tube designs were tested under various gas flow conditions for accuracy in measuring static and total pressure. The static- and impact-pressure measuring tubes least affected by angular flow were combined and then evaluated in the presence of standard particulate sampling nozzles. Tests were performed on 'S', 'L', Kiel and cylinder pitot tubes and a shielded static-pressure pitot tube. The percent error for each pitot tube was determined as a function of yaw, pitch, orifice size, orifice location, pitot tube size, and velocity. A pitot tube was developed that is accurate within 5% when yawed and pitched + or - 30 degrees even while attached to a standard EPA Method 5 sampling assembly. This pitot tube was field tested at a sewage sludge incinerator, a clay crushing plant and a power plant. Also included in the report are: a summary of the existing literature on design of 'L' pitot tubes; a summary of the present state-of-the-art in sampling stacks with cyclonic flow and the errors involved in such sampling; a recommendation for straightening cyclonic flow by insertion of a venturi throat; and the effect of Reynolds Number on pitot tube accuracy.

UNDERGROUND ENGINEERING

21051 (LA-UR—80-742) **Subterranean stress engineering experiments.** Campbell, J.R.; Colgate, S.A.; Wheat, B.M. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 15p. (CONF-800522—1). Dep. NTIS, PC A02/MF A01.

From 13. symposium on rock mechanics; Ontario, Canada (28 May 1980).

The state of stress in a subterranean rock mass has classically been assumed to be constant at best. In soil with a high clay content, preconsolidation and drainage methods can lead to more stable foundation material, but methods for engineering the stresses in large masses of rock are not well known. This paper shows the results from an experiment designed to alter the in situ rock stress field in an oil shale mine. This was done by hydrofracturing the rock by use of a packed-well injection system and then propping the crack open with a thixotropic gel, which slowly hardened to the consistency of cement. Successive hydrofracture and high-pressure grouting resulted in an overstressed region. Well-head injection pressures, surface tilts, injection rates, and subterranean strains were measured and recorded on floppy disk by a Z-80 microprocessor. The results were then transmitted to the large computer system at the Los Alamos Scientific Laboratory (LASL). To put the data in a more useful form, computer-generated movies of the tilts and strains were made by use of computer graphics developed at LASL. The purpose of this paper is to present results from the Single Large Instrumented Test conducted in the Colony Oil Shale Mine near Rifle, Colorado. 13 figures.

POLLUTION CONTROL EQUIPMENT

21052 (PB—80-112659) **Assessment of manufacturers' capabilities to meet requirements for control of emissions of sulfur dioxide, particulate matter, and nitrogen oxides from industrial boilers. Final report.** (Industrial Gas Cleaning Inst., Inc., Alexandria, VA (USA)). Oct 1979. Contract EPA-68-02-2532. 155p. NTIS, PC A08/MF A01.

The report reviews the capabilities of manufacturers of air pollution control equipment to produce sufficient numbers of control devices for new industrial boilers with heat inputs greater than 2.9 MW thermal, should regulations be promulgated. The report covers the period 1981 to 1995. The supply of flue gas desulfurization systems will be inadequate if controls are required on small boilers. The supply of systems to control particulate matter emissions, however, should be satisfactory. The industry providing systems to treat nitrogen oxides in flue gas is poorly developed and apparently could not supply enough systems for all industrial boilers. Limited data are available about combustion modification for nitrogen oxide control, but the combustion modification industry appears abler than the flue gas treatment industry to meet a demand for more stringent control of nitrogen oxide emissions.

21053 (PB—80-113673) **NO/sub x/ abatement for stationary sources in Japan. Annual report, June 1978-June 1979.** Ando, J. (Chuo Univ., Tokyo (Japan)). Aug 1979. Contract EPA-68-02-2161. 496p. NTIS, PC A21/MF A01.

The report describes current NOx air pollution problems in Japan and the methods used there to control NOx emissions from stationary sources. The two most common techniques in use are combustion modifications and flue gas treatment (FGT). FGT technologies have been developed more extensively in Japan than in any other country as a result of Japan's stringent NOx emission standards. The various NOx control technologies are examined with respect to both principles of operation and specific process applications. Currently the most popular (over 60 commercial applications) FGT technology is selective catalytic reduction. This technology is capable of 80-90% NOx control and has the lowest cost per kilogram of NOx removed. Recently catalysts have been developed that are resistant to particulate plugging and appear to be applicable to coal-fired boilers in the U.S. Cost and commercial performance data, based on Japanese installations, are presented in much greater detail than was previously available.

POWER CYCLES

REFER ALSO TO CITATION(S) 20428

PARTICLE ACCELERATORS

REFER ALSO TO CITATION(S) 21180

DESIGN, DEVELOPMENT, AND OPERATION

21054 (CONF-791058—67) **Neutron cross section measurements at ORELA.** Dabbs, J.W.T. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 7p. Dep. NTIS, PC A02/MF A01.

From International conference on nuclear cross sections for technology; Knoxville, TN, USA (22 Oct 1979).

ORELA (Oak Ridge Electron Linear Accelerator) has been for the last decade the most powerful and useful pulsed neutron time-of-flight facility in the world, particularly in the broad mid-drange of neutron energies (10 eV to 1 MeV). This position will be enhanced with the addition of a pulse narrowing prebuncher, recently installed and now under test. Neutron capture, fission, scattering, and total cross sections are measured by members of the Physics and Engineering Physics Divisions of ORNL, and by numerous guests and visitors. Several fundamental and applied measurements are described, with some emphasis on instrumentation used. The facility comprises the accelerator and its target(s), 10 evacuated neutron flight paths having 18 measurement stations at flight path distances 8.9 to 200 meters, and a complex 4-computer data acquisition system capable of handling some 17,000 32-bit events/s from a total of 12 data input ports. The system provides a total of 2.08×10^6 words of data storage on 3 fast disk units. In addition, a dedicated PDP-10 timesharing system with a 250-megabyte disk system and 4 PDP-15 graphic display satellites permits on-site data reduction and analysis. More than 10 man-years of application software development supports the system, which is used directly by individual experiments. 12 figures, 1 table.

BEAM DYNAMICS, FIELD CALCULATIONS, AND ION OPTICS

REFER ALSO TO CITATION(S) 21089

21055 (LA—8271-MS) **Computer program to fit a hyperellipse to a set of phase-space points in as many as six dimensions.** Wadlinger, E.A. (Los Alamos Scientific Lab., NM (USA)). Mar 1980. Contract W-7405-ENG-36. 14p. Dep. NTIS, PC A02/MF A01.

A computer program that will fit a hyperellipse to a set of phase-space points in as many as 6 dimensions was written and tested. The weight assigned to the phase-space points can be varied as a function of their distance from the centroid of the distribution. Varying the weight enables determination of whether there is a difference in ellipse orientation between inner and outer particles. This program should be useful in studying the effects of longitudinal and transverse phase-space couplings.

21056 (LA—8288-MS) **Space-charge limit for a drift-tube linac from the stability point of view of longitudinal periodicity.** Inagaki, S. (Los Alamos Scientific Lab., NM (USA)). Mar 1980. Contract W-7405-ENG-36. 11p. Dep. NTIS, PC A02/MF A01.

A method to estimate the space-charge limit for a drift-tube linac, using the strong focusing theory for the longitudinal oscillation and the space-charge theory by Vlasov, is described. Because of the periodicity of the drift tubes and the gaps, the structure can be considered as a longitudinal alternating gradient focusing system analogous to the transverse alternating gradient focusing using quadrupoles. An upper current limit is obtained from the stability point of view.

21057 (LA—8289-MS) **Radial focusing and space charge in an alternating-phase-focusing linac.** Inagaki, S. (Los Alamos Scientific Lab., NM (USA)). Mar 1980. Contract W-7405-ENG-36. 13p. Dep. NTIS, PC A02/MF A01.

Using the strong focusing theory for the phase-energy space, it is possible to find the space-charge limit of an Alvarez linac or to find the appropriate combination of the synchronous phases for an alternating-phase-focusing (APF) linac. In a linac design, it is common to use the integral form to compute the transverse dynamics. This report will show that the use of the differential form and of the periodicity condition gives the space-charge term and the appropriate combination of the synchronous phases for the radial oscillation.

21058 (LA—8290-MS) **Longitudinal capture in the radio-frequency-quadrupole structure.** Inagaki, S. (Los Alamos Scientific Lab., NM (USA)). Mar 1980. Contract W-7405-ENG-36. 32p. Dep. NTIS, PC A03/MF A01.

The radio-frequency-quadrupole (RFQ) linac structure not only can attain easily transverse focusing in the low-beta region, but also can obtain very high capture efficiency because of its low beta-lambda and low-particle rigidity. An optimization study of the zero space-charge longitudinal capture in an RFQ linac that yields configurations with large capture efficiency is described.

21059 (LA-tr—80-8) **Energy relationships in continuous beams (generalized Kapchinskii/Vladimirskii equations).** Lapostolle, P.M. (European Organization for Nuclear Research, Geneva (Switzerland)). 1980. Translation of CERN-ISR-DI/71-6, March 1971. 59p. Dep. NTIS, PC A04/MF A01.

Non-linear space charge properties of accelerator beams are discussed. Topics covered include: total energy in a beam, space charge energy, case of a rotating beam; space charge energy in a beam without rotational symmetry; other expressions for the space charge energy; comparison to the equations of Kapchinskii and Vladimirskii; generalized K/V equations; energy equations form of K/V equations; application of generalized K/V equations, variation in quadratic mean emittances; and recommendations for future study. (GHT)

21060 **Improvement in beam current performance of the biomedical cyclotron at Memorial Sloan-Kettering Cancer Center.** Kuo, T.Y.T.; Laughlin, J.S. (Memorial Sloan-Kettering Cancer Center, New York, NY). *Prog. Nucl. Med.;* **4**: 6-15(1978).

The Sloan-Kettering cyclotron, except for its limited energy, has become a more versatile and powerful accelerator than it was intended. Four types of particle can be accelerated at all ranges of current level. Two design merits achieved by TCC provided the possibility for such a performance. There have been frequent change-overs but the operation has been simple and expeditious. Routine operations are usually carried out by users. Beam current stability can be maintained by various automatic control devices and the cyclotron can be left unattended. Reliability has been greatly upgraded as a result of many engineering improvements. Although there are still some remaining problems to be resolved, e.g., the power disspiation in the central region, some of the techniques developed so far can be applied to other cyclotrons built by TCC. High beam current may not be needed in some laboratories, yet the simplicity and versatility of operation may be of general interest.

AUXILIARIES AND COMPONENTS

REFER ALSO TO CITATION(S) 21054, 21100

21061 **LSI-11 based auxiliary crate controller for beam line and experiment control.** Kozlowski, T.; Machen, D.R.; Potter, J.M. (Univ of Calif, Los Alamos Sci Lab, NM). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 4, 4601-4605(Aug 1979).

A beam line control system using an Auxiliary Crate Controller incorporating a LSI-11/2 processor has been developed at the Clinton P. Anderson Meson Physics Facility. The LSI-11 runs under the RSX-11S operating system and by means of a specially designed control console allows easy implementation of beam line and experiment controls independent of a larger computer system.

ION SOURCES

21062 (UCID—18568) **Two-dimensional gas flow in an electrode assembly.** Hamilton, G.W.; Willmann, P.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 Apr 1980. Contract W-7405-ENG-48. 25p. Dep. NTIS, PC A02/MF A01.

The interface between a source of positive or negative ions and a multichannel MEQALAC accelerator will be the Low-Energy Beam Transport (LEBT) consisting of a lattice of quadrupole focusing electrodes transporting the beam while the gas pressure is reduced from the high-pressure ion source to the low-pressure accelerator. Gas emitted from the ion source will flow through the LEBT electrode lattice to a pumping volume. It is necessary to analyze the two-dimensional gas flow to ascertain the gas densities throughout the LEBT and to design the system so that only a small fraction of the ion beam is lost by gas collisions. The analysis uses the fact that the gas-flow rate is proportional to the density gradient if the mean free path of the low-pressure gas is greater than the inter-electrode spacing. Consequently the mathematics developed for conductivity of heat or electric current can be used. The practical result of this analysis is to determine the maximum width of the LEBT so that the beam loss by gas collisions is tolerable. The maximum width is a function of beam density, gas efficiency, and electrode spacing. The beam current per unit length of module will be somewhat greater than 75 mA/cm. Electrode dimensions should be chosen to fit the characteristics of the ion source.

EXPERIMENTAL FACILITIES AND EQUIPMENT

REFER ALSO TO CITATION(S) 21060, 21095, 21114

21063 (ANL-HEP-CP—80-09) **ZGS highlights and speculations.** Fields, T.H. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 13p. (CONF-7909111—3). Dep. NTIS, PC A02/MF A01.

From Symposium on the history of the ZGS; Argonne, IL, USA (13 Sep 1979).

Several examples of unfinished business of the ZGS program are described. These examples cover physics, apparatus, and institutional subjects. Speculations are given about the evolution of these subjects during the 1980's.

21064 (CONF-791092—3) **Summary report on the Oak Ridge 25 MV tandem accelerator.** Alton, G.D.; Bair, J.K.; Benjamin, J.A.; Biggerstaff, J.A.; Jones, C.M.; Juras, R.C.; Mann, J.E.; Richardson, E.G.; Weisser, D.C.; Ziegler, N.F. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 3p. Dep. NTIS, PC A02/MF A01.

From Symposium of northeastern accelerator personnel; Philadelphia, PA, USA (8 Oct 1979).

Status of the ORNL 25 MV tandem accelerator is given. Topics include: installation; voltage test details; ORNL development activities including stripper foil studies, air-SF_6 separation, CAMAC buncher controller, and ion source development. (GHT)

21065 (CONF-7910119—4) **Lifetime measurements on carbon stripper foils.** Auble, R.L.; Galbraith, D.M. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 17p. Dep. NTIS, PC A02/MF A01.

From 8. annual conference of the I.N.T.D.S.; Boston, MA, USA (1 Oct 1979).

Fabrication of carbon stripper foils and their performance in electrostatic accelerators are described. (GHT)

21066 (LA—8218-PR) **Accelerator technology program. Progress report, January-March 1978.** Knapp, E.A.; Jameson, R.A. (comps.). (Los Alamos Scientific Lab., NM (USA)). Feb 1980. Contract W-7405-ENG-36. 82p. Dep. NTIS, PC A05/MF A01.

The Accelerator Technology (AT) Division was formed on January 1, 1978, to consolidate groups and activities throughout the Los Alamos Scientific Laboratory (LASL) involved in accelerator technology. The AT Division concentrates on the extension of state-of-the-art accelerators to contemporary and future applications, through basic research into beam dynamics phenomena, and applied research and development in all aspects of accelerator systems, including beam transport systems, accelerator structures, and radio-frequency systems. Programs within the division focus on accelerator development activities on linear and recirculating machines for a variety of practical applications, including cancer therapy using pion or neutron beams; electronuclear fuel production feasibility; high-performance linear accelerator systems; the proton storage ring (PSR) at the Clinton P. Anderson Meson Physics Facility (LAMPF); and materials irradiation testing for fusion reactors. This first quarterly progress report emphasizes the program objectives and technology areas studied during AT's first 3 months.

21067 **Topical conference on computerized data-acquisition systems in particle and nuclear physics, 1979.** (IEEE, Nucl and Plasma Sci Soc, New York, NY). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 4, 4365-4678(Aug 1979).

This conference proceedings contains 52 papers. 52 papers are indexed separately. Topics covered include the following: university systems; national laboratory systems; integrated facility-wide systems; data capture interface hardware; user interface hardware; software systems; future systems; data analysis; and experiment control.

21068 (PB—296947, pp 38-48) **Health physics considerations in accelerator decommissioning and disposal.** Mundis, R.L.; Kikta, M.J.; Marmer, G.J.; Opelka, J.H.; Peterson, J.M.; Siskind, B. (Argonne National Lab., IL). May 1979.

From 12. Health Physics Society midyear topical symposium; Williamsburg, VA, USA (12 Feb 1979).

There are perhaps as many as 1200 particle accelerators in the United States, ranging in size from the very small Cockroft-Walton and electron linear accelerators to the multi-GeV research synchrotrons. When an accelerator has reached the end of its useful life the radioactivity induced in the components then presents several disposal problems. At least fifty accelerators produce significant induced activation, and several hundred more are capable of producing fluxes of neutrons which could result in activation of various components of the accelerator facility. This is generally of low level except for the very high energy/high intensity machines. In most cases, the induced radioactivity is confined to relatively few parts of the machine and the disposition of these is through the normal radioactive waste channels without complication. However, some machines leave a legacy of low level induced radioactivity in massive components. Examples of massive items are large magnets, shield blocks and beam stops of concrete, earth or iron, and even the walls and floors of the building itself. These need to be dealt with in a manner so as to pose no potential health hazards to persons in the vicinity of the public at large. The disposition of radioactive waste from major past decommissionings, including the Cambridge Electron Accelerator (CEA) and the Brookhaven Cosmotron, will be discussed. The extent of the induced radioactivity problmes in decommissioning of smaller accelerators will also be discussed.

21069 **Proposed computing facilities for Triangle Universities Nuclear Laboratory.** Gould, C.R.; Roberson, N.R.; Edwards, S.E.; Jensen, M.; Wender, S.A. (NC State Univ, Raleigh). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 4, 4373-4377(Aug 1979).

The current computing facilities at TUNL have been in operation for 14 years. Design considerations for a new computer system, to be installed and operational by mid 1980, are discussed. The new large-memory 32-bit minicomputers appear to provide the most cost-effective way of handling the data acquisition and analysis needs of a medium-sized nuclear physics laboratory.

21070 **Data acquisition and analysis on the high resolution magnetic spectrometers at LAMPF.** Amann, J.F.; Boudrie, R.L.; Thiessen, H.A.; Morris, C.L.; Smith, L.E. *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 4, 4389-4394(Aug 1979).

The data acquisition and analysis system for LAMPF's high-resolution magnetic spectrometers, HRS and EPICS, consists of two on-line PDP-11/45 computers and an off-line PDP-11/60 for analysis of taped data. Each system has 124K words of memory and runs under DEC's RSX-11D operating system. The on-line computers are interfaced to several CAMAC crates through a Microprogrammable Branch Driver (MBD). Each system is also equipped with two Tektronix, 4010 terminals, a Versatec printer/plotter, at least one RK05 disk drive, a 9 track 75 IPS 800/1600 BPI Kennedy tape drive, and a 40MB Diva/Calcomp disk drive system which is compatible with DEC software for their RP03. The software developed for these systems was designed to meet the goals of flexibility and speed of analysis for multiparameter data (20-100 words/event).

21071 **Crystal ball data acquisition system.** Chestnut, R.; Kiesling, C.; Bloom, E.; Bulos, F.; Gaiser, J.; Godfrey, G.; Oreglia, M.; Partridge, R.; Peck, C.; Porter, F.; Aschman, D.; Cavali-Sforza, M.; Coyne, D.; Sadrozinski, H.; Kollmann, W.; Richardson, M. (Stanford Univ, Calif). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 4, 4395-4398(Aug 1979).

The data acquisition system for the Crystal Ball project at SLAC is described. A PDP-11/t55 using RSX-11M connected to the SLAC Triplex is the basis of the system. A "physics pipeline" allows physicists to write their own equipment-monitoring or physics tasks which require event sampling. As well, an interactive analysis package (MULTI) is in the pipeline. Histogram collection and display on the PDP are implemented using the Triplex histogramming package. Various interactive event displays are also implemented.

21072 **Data acquisition and analysis system for the Holifield Heavyy Ion Research Facility.** Milner, W.T.; Biggerstaff, J.A.; Hensley, D.C.; Sayer, R.O. *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 4, 4399-4404(Aug 1979).

The Holifield Heavy Ion Research Facility is a national resource which will serve a large number of nuclear and atomic physicists who expect to perform experiments which vary widely in type and complexity. Although much consideration must be given to the problem of rapid acquisition and processing of many-parameter data, an equal emphasis will be placed on operational simplicity and the standardization of hardware and software. Two "active" experimental counting areas and two or more "setup" areas are served by three remotely located Perkin-Elmer 8/32 computers which are interfaced to the user equipment by means of three CAMAC branch highways. Other equipment includes a large disk system, alphanumeric/graphic terminals and printer-plotters located in each of the counting areas.

21073 **Distributed processing data acquisition system at Brookhaven National Laboratory.** Lee, R.C.; Scheetz, R.A. (Brookhaven Natl Lab, Upton, Ny). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 4, 4405-4408(Aug 1979).

The Tandem Van de Graaff at BNL has been using a computerized data acquisition system for more than eight years. A brief history of its philosophy and performance is discussed. Also presented is the new data collection system which is designed around a high-speed bus with multiple processors. This new system is capable of handling event rates of over 200 kHz for add-one to memory (PHA) type spectra totalling 512k channels. List-mode, special sorting involving gating, or arithmetic operations of the data are supported in addition to one or two parameter PHA types. The system allows eight configurations of eight devices to be defined by the user. The devices are typically analog-to-digital converters (ADCs), multi-channel scalers, or routing devices. However any device with digital information could be interfaced.

21074 **MINUS3: general purpose data acquisition system at LBL's 88"-Cyclotron and SuperHILAC.** Maples, C.; Sivak, J. (Univ of Calif, Lawrence Berkeley Lab). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 4, 4409-4416(Aug 1979).

MINUS3 is a general, multi-tasked data acquisition package operating on the ModComp IV/25 computers at both the 88"-

Cyclotron and SuperHILAC. It currently can acquire data via three different channels: interrupt, serial DMA link, and remote slave units for histogram-type data. Two additional acquisition paths, CAMAC (with programmable differential branch drivers) and MODACS (for multiple CPU linkages and control) are scheduled to be added in the near future. The package operates in a prioritized, time-available mode which permits it to adapt dynamically to microscopic data rate structures due to beam characteristics at different accelerators. Special hardware has been added to the graphics system to provide enhanced high-speed interactive capability. The program framework is also designed as a parasitic environment in which users may, in parallel, attach their own specialized and independent code.

21075 LAMPF standard data-acquisition system. Perry, D.G. (Los Alamos Sci Lab, NM). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 4, 4422-4426(Aug 1979).

LAMPF has made a serious attempt to standardize its data-acquisition systems for all the experimental beam ports of the facility. Some of the benefits and pitfalls of this standardization effort are discussed, as well as the philosophy behind the chosen standard configuration.

21076 RT/RSX MULTI: packages for data acquisition and analysis in high-energy physics. Bartlett, J.F.; Biel, J.R.; Curtis, D.B.; Dosen, R.J.; Lagerlund, T.D.; Ritchie, D.J.; Taff, L.M. (Fermi Natl Accel Lab, Batavia, Ill). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 4, 4427-4432(Aug 1979).

The MULTI system is a software package for data acquisition, data analysis, and experiment control. PDP-11 implementations are in widespread use under the RT-11 and RSX-11M operating systems at Fermilab and elsewhere. The system philosophy, architecture, and significant features are discussed, and the measured performance is reported.

21077 Event Handler--II. A fast, programmable, CAMAC-coupled data acquisition interface. Hensley, D.C. (Oak Ridge Natl Lab, Tenn). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 4, 4454-4458(Aug 1979).

A description is given of the architecture of the Event Handler II, a fast, programmable data acquisition interface which is linked to and through CAMAC. The special features of this interface make it a powerful tool in implementing data acquisition systems for experiments in nuclear physics.

21078 Data display with the Q system. Oothoudt, M.A. (Univ of Calif, Los Alamos, NM). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 4, 4473-4476(Aug 1979).

The Q data-acquisition system for PDP-11 minicomputers at the Clinton P. Anderson Meson Physics Facility (LAMPF) provides experiments with basic tools for on-line data display. Tasks are available to plot one- and two-parameter histograms on Tektronix 4000 series storage-tube terminals. The histograms to be displayed and the display format may be selected with simple keyboard commands. A task is also available to create and display live two-parameter scatter plots for any acquired or calculated quantities. Other tasks in the system manage the display data base, list display parameters and histogram contents on hardcopy devices, and save core histograms on disk or tape for off-line analysis.

21079 Multiparameter data acquisition and display program. Sunier, J.W.; Poore, R.V.; McMillan, D.E. (Los Alamos Sci Lab, NM). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 4, 4485-4488(Aug 1979).

A general-purpose multiparameter data-acquisition, histogramming and display program is presented. The 32 input parameters of the program consist of up to 16 CAMAC words of 16 bits, and up to 16 algebraic functions of these words. Up to 64 one- and two-dimensional histograms based on these parameters can be constructed, subject to up to 144 correlated conditions imposed on the input parameters. The display system consists of a rapid refresh scope with 10-bit X and Y resolution, and a push-button panel, specifically designed to interact dynamically with either the display or the data acquisition programs. Typical event rates vary between 300 Hz and 10 kHz, depending on the number of histograms generated and on their filtering conditions.

21080 Q system: an experiment in software standardization for data acquisition. Perry, D.G. (Los Alamos Sci Lab, NM). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 4, 4494-4499(Aug 1979).

The LAMPF standard data-acquisition software system Q has been developed by many people so that it currently represents about 10 man-years of effort. The Q system provided the modular software tools a physicist needs to set up a working data-acquisition system. The components of Q are a data-acquisition language, a histogram package, a display package, automatic taping of data, and a standard hardware interface. An overview of the Q system is given along with a discussion of the basic philosophy of the approach taken in its development. Future developments will also be mentioned.

21081 Implications of modern syntactic style on the "QAL" data-acquisition language. Nartker, T.A.; Orr, P.K.; Stavely, A.M.; Perry, D.G. (NM Tech, Socorro). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 4, 4505-4507(Aug 1979).

The "Q" data-acquisition software system has, for the last several years, provided most of the abilities required by experimenters in nuclear physics at LAMPF. The system allows its user to select and record the required data at very high speed using a simple notation. It is not necessary to become familiar with machine level programming considerations to use the system. Partial results are reported of a study of the "QAL" language with special emphasis on improvements suggested by recent progress in the field of programming language design. The results indicate that some features of new programming languages would solve some of the problems users have with the current system. It is also possible to capture the abilities of the current system within a PASCAL-like syntax without sacrificing efficiency.

21082 QAL: a language for nuclear physics data acquisition. Perry, D.G. (Los Alamos Sci Lab, NM). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 4, 4508-4522(Aug 1979).

QAL is a data-acquisition language designed to facilitate the experimental interface to the LAMPF-designed Q data-acquisition system. The language constructs available are reviewed. The language is designed around the CAMAC standard and provides experimenters a language interface to the hardware which is easy to understand. Software written in the QAL language is modular and simple to modify.

21083 Fast first pass at the future FASTBUS. Droege, T.F.; Turner, K.J. (Fermi Natl Accel Lab, Batavia, Ill). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 4, 4543-4547(Aug 1979).

In July, 1975 efforts were initiated to develop a new standard structure for processing digital information with emphasis on very large, very high data rate experiments. This effort is currently called the "FASTBUS". At this time, the design of the bus appears to be solidifying--at least to the extent that the specifications can be "tried on for size" to a real project. At Fermilab a commitment has been made to use the FASTBUS in the Colliding Detector Facility and a smaller preliminary project, E594. This study examines these projects for fit.

21084 Data acquisition and control system for the IPNS time-of-flight neutron scattering instruments. Daly, R.T.; Haumann, J.R.; Kraimer, M.R.; Lenkszus, F.R.; Lidinsky, W.P.; Morgan, C.B.; Rutledge, L.L.; Rynes, P.E.; Tippie, J.W. (Argonne Natl Lab, Ill). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 4, 4554-4563(Aug 1979).

The Argonne Intense Pulsed Neutron System (IPNS-I) presently under construction at Argonne National Laboratory will include a number of neutron scattering instruments. This study investigates the data acquisition requirements of these instruments and proposes three alternative multiprocessor systems which will satisfy these requirements. All proposals are star configurations with a super-mini as the central node or HOST. The first proposal is based on front-ends composed of two or more 16-bit microcomputers, the second proposal is based on front ends consisting of a combination of a mini and microcomputers, and the third is based on a minicomputer with an intelligent CAMAC controller.

21085 HISS computer facility. McParland, C.P. (Univ of Calif, Lawrence Berkeley Lab). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 4, 4564-4566(Aug 1979).

Increased computing needs of the Heavy Ion Spectrometer System (HISS) at the LBL Bevalac have prompted the design and construction of a data-acquisition/data analysis computer facility. The design incorporates a VAX 11/780 for data analysis along with a PDP 11/45 for data acquisition (via CAMAC). The two machines communicate via a shared 80-megabyte disk. The design also allows the addition of other data acquisition machines sharing the same disk system. The considerations that led to the selected design are presented along with an overview of the planned software systems.

21086 Philosophy of a computer-automated counting system. Perry, D.G.; Giesler, G.C. (Los Alamos Sci Lab, NM). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 4, 4591-4595(Aug 1979).

The LAMPF (Los Alamos Clinton P. Anderson Meson Physics Facility) Nuclear Chemistry computer system is designed to provide both real-time control of data acquisition and facilities for data processing for a large variety of users. It is a PDP-11/34 connected to a parallel CAMAC branch highway as well as a large variety of peripherals. The philosophy for the design of this system is discussed, and covers such points as use of the computer for control only versus direct data acquisition by the computer, why a CAMAC system was chosen, and the advantages and disadvantages of this system. Also discussed are future expansion of the system and what might be done differently if the system were redesigned.

21087 Multichannel electrometer data-acquisition system. Somers, J.; Hogstrom, K.R.; Slice, R.T.; Rosen, I.I.; Smith, A.R. *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 4, 4596-4600(Aug 1979).

A multichannel electrometer data-acquisition system, with associated software control, has been developed for dosimetry measurements of the pion beam at the Clinton P. Anderson Meson Physics Facility in Los Alamos, New Mexico. This system increases dosimetry data-acquisition rates by a factor equal to the number of data channels in use. It is based on a newly-developed electrometer amplifier capable of accurate measurements at picoampere signal levels. Design and construction of the electrometers are presented here in detail, and examples of data acquired with this system are presented. The effect on the readings due to scattered and background radiation has been measured.

21088 Microprocessor-controlled target polarization monitor. Buchanan, J.A.; Clement, J.M. (Rice Univ, Houston, Tex). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 4, 4614-4617(Aug 1979).

The proton spin polarization of an ethylene glycol target is measured using a nuclear magnetic resonance system controlled by a DEC LSI-11 microprocessor. Programs to accomplish data acquisition and polarization computation are down-loaded via CAMAC from the host DEC 11/45 computer. After initialization, the Polarization Monitor operates autonomously but presents data to the host computer on demand.

STORAGE RINGS

21089 (BNL—27390) **Nonlinear interaction of colliding beams in particle storage rings.** Herrera, J.C.; Month, M. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 23p. (CONF-791240—1). Dep. NTIS, PC A02/MF A01.

From International conference on nonlinear dynamics; New York, NY, USA (17 Dec 1979).

When two beams of high energy particles moving in opposite directions are brought into collision, a large amount of energy is available for the production of new particles. However to obtain a sufficiently high event rate for rare processes, such as the production of the intermediate vector boson (Z_o and W^{+-}), large beam currents are also required. Under this circumstance, the high charge density of one beam results in a classical electromagnetic interaction on the particles in the other beam. This very nonlinear space charge force, caled the beam-beam force, limits the total circulating charge and, thereby, the ultimate performance of the colliding ring system. The basic nature of the beam-beam force is discussed, indicating how it is quite different in the case of continuous beams, which cross each other at an angle as compared to the case of bunched beams which collide head-on. Some experimental observations on the beam-beam interaction in proton-proton and electron-positron beams are then reviewed and interpreted. An important aspect of the beam-beam problem in storage rings is to determine at what point in the analysis of the particle dynamics is it relevant to bring in the concepts of stochasticity, slow diffusion, and resonance overlap. These ideas are briefly discussed.

INSTRUMENTATION

RADIATION INSTRUMENTATION

GENERAL DETECTORS AND MONITORS

REFER ALSO TO CITATION(S) 21098, 21528

21090 (CONF-791051—20) **Status report on activities of A STM E10.05.01 Task Group on Uncertainty Analysis.** Kam, F.B.K.; Stallman, F.W. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 8p. Dep. NTIS, PC A02/MF A01.

From 3. ASTM-EURATOM symposium on reactor dosimetry; Ispra, Italy (1 Oct 1979).

Uncertainties in the field of reactor dosimetry are analyzed. A survey on uncertainty analysis as it is practiced at leading laboratories which are involved in reactor dosimetry is described. A questionnaire was prepared and mailed to about 45 installations and researchers. Nine replies were received, several of them were prepared by more than one author. Three of the nine came from installations outside the US. Results and the questionnaire are presented.

21091 (EUR—6108, pp 506-529) **Neutron sensitivity of capture gamma ray detectors.** Allen, B.J.; Musgrove, A.R. de L. (Australian Atomic Energy Commission Research Establishment, Lucas Heights); Macklin, R.L. (Oak Ridge National Lab., TN (USA)); Winters, R.R. (Denison Univ., Granville, OH (USA)). 1979.

In Neutron data of structural materials for fast reactors. Proceedings of a specialists' meeting, Geel, Belgium, 5-8 December 1977.

Methods for the determination of the neutron sensitivity of capture γ-ray detectors are presented. The contribution of resonance scattered neutrons to the capture yield is determined by Monte Carlo analysis using an empirical description for capture by the constituents of the detector and environs. Parameters of scattering resonances in the keV region are presented for a range of nuclides.

21092 Use of a large time-compensated scintillation detector in neutron time-of-flight measurements. Goodman, C.D. (to Dept. of Energy). US Patent 4,180,736. 25 Dec 1979. Filed date 25 Sep 1978. 6p.

PAT-A PPL-945,375.

A scintillator for neutron time-of-flight measurements is positioned at a desired angle with respect to the neutron beam, and as a function of the energy thereof, such that the sum of the transit times of the neutrons and photons in the scintillator are substantially independent of the points of scintillations within the scintillator. Extrapolated zero timing is employed rather than the usual constant fraction timing. As a result, a substantially larger scintillator can be employed that substantially increases the data rate and shortens the experiment time. 3 claims.

21093 Fast multiwire proportional chamber data encoding system for proton tomography. Brown, D. (Los Alamos Sci Lab, NM). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 4, 4606-4613(Aug 1979).

A data encoding system that rapidly generates the binary address of an active wire in a 512-wire multiwire proportional chamber has been developed. It can accept a second event on a different wire after a deadtime of 130 ns. The system incorporates preprocessing of the wire data to reject events that would require more than one wire address. It also includes a first-in, first-out memory to buffer the data flow. 4 refs.

RADIATION DOSEMETERS

REFER ALSO TO CITATION(S) 21087

NUCLEAR SPECTROSCOPIC INSTRUMENTATION

REFER ALSO TO CITATION(S) 20606, 20620, 20872, 21085, 21116

HIGH ENERGY PHYSICS INSTRUMENTATION

21094 Automatic digitization of optical spark chamber data using charge coupled devices. Bross, A.; Brown, R.; Downing, R.; Fuess, S.; Kohlmeier, J.; Nienaber, P.; Richardson, D.; Simaitis, V.; Virkus, R. (Univ of Ill, Urbana). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 4, 4531-4542(Aug 1979).

A system of charge-coupled imagers capable of recording optical spark chamber data has been developed. The operation of charge-coupled devices (CCD's) is discussed and details of systems utilizing single and multiple CCD imagers are presented. Data taken using a multiple CCD system in parallel with film are given. CCD sensitivity, spatial resolution and accuracy are discussed and comparisons are made between CCD data and that obtained from film.

21095 On-line polynomial optimization for high resolution spectrometers. Boudrie, R.L.; Amann, J.F.; Morris, C.L.; Thiessen, H.A.; Smith, L.E. *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 4, 4588-4590(Aug 1979).

A method has been developed to use a standard linear least squares routine to optimize various calculated quantities for the high-resolution magnetic spectrometers of EPICS and HRS at LAMPF. Calculated quantities, such as x position at the target, can be expressed as polynomials of other calculated quantities and positions and angles directly determined by wire chambers. For each event (particle through the spectrometer) that satisfies predetermined limits, these coordinates (position, angle, momentum, etc.) are written to a disk file. A program which includes a linear least squares routine can then take an unlimited number of these events and do a fit to a polynomial consisting of terms which are up to fourth order in the coordinates of these events.

RADIOMETRIC INSTRUMENTS

REFER ALSO TO CITATION(S) 21101

21096 (PNL-SA—7738) **Comparison of systems for high speed surface flaw measurements of cartridges.** Swinth, K.L.; Kirihara, L.J.; Coleman, W.J. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1979. Contract EY-76-C-06-1830. 18p. (CONF-790838—4). Dep. NTIS, PC A02/MF A01.

From 23. annual international symposium of the Society of Photographic Instrumentation Engineers; San Diego, CA, USA (27 Aug 1979).

Instrumentation to detect surface flaws in cartridge cases has been developed for high speed on-line inspection. Scattering of light from a line focused on the case surface indicates the presence of

surface flaws and the instrumentation permits rough categorization of flaws into dents and scratches. Two methods of light detection have been implemented, and the purpose of this paper is to compare these techniques. The first technique uses fiber optics to collect the scattered light and carry it to a photomultiplier tube to generate a signal, which the second technique uses solid-state diodes to produce the signal. Angled surfaces such as the shoulder on the cartridge case influence the response of the fiber-optics due to the acceptance cone of the fibers. To circumvent this problem, the fibers must be judiciously positioned during manufacture of the fiber-optic bundles. The solid-state diodes do not have the limited acceptance angle and thus provide more uniform response. However, the diodes require placement of electronics on the rotating exam wheel near the detectors. The processing electronics for both systems are identical.

MISCELLANEOUS INSTRUMENTS

REFER ALSO TO CITATION(S) 19935, 19947, 20599, 21079, 21088

21097 High-voltage crowbar circuit with cascade-triggered series ignitrons. Baker, W.R. US Patent Application 000,740. [nd]. 12p.

A series string of ignitrons for switching a large current at high voltage to ground is discussed. Switching is initiated by means of a negative trigger pulse applied to the cathode of the lowest voltage level ignitron next to ground to draw ground current through diodes in the ignitor circuit. The trigger pulse is applied thereby to the next higher ignitron cathode and sequentially to the remainder of the ignitrons in the string through diodes in respective ignitor circuits. Full line voltage is held off of nonconducting diodes and ignitrons by means of varistors.

21098 Multiplexer and time duration measuring circuit. Gray, J. Jr. US Patent Application 028,741. [nd]. 8p.

A multiplexer device is provided for multiplexing data from a plurality of pulse sources to a master storage and includes a D type flip-flop.

21099 Apparatus for generating nonlinear pulse patterns. Nakamura, N.M.I. US Patent Application 047,449. [nd]. 20p.

Apparatus for generating a plurality of nonlinear pulse patterns from a single linear pulse pattern. A first counter counts the pulses of the linear pulse pattern and a second counter counts the pulses of the nonlinear pulse pattern. A comparator compares the counts of both counters, and in response to an equal count, a gate is enabled to gate a pulse of the linear pattern as a pulse of the nonlinear pattern, the latter also resetting the first counter. Presettable dividers divide the pulses of each pattern before they are counted by the respective counters. Apparatus for generating a logarithmic pulse pattern from a linear pulse pattern to any log base is described. In one embodiment, a shift register is used in place of the second counter to be clocked by each pulse of the logarithmic pattern to generate the pattern. In another embodiment, a memory stores the logarithmic pattern and is addressed by the second counter which is clocked by the pulses of the logarithmic pulse pattern.

21100 Automatic readout micrometer. Lauritzen, T. US Patent Application 045,170. [nd]. 18p.

A measuring system is described for surveying and very accurately positioning objects with respect to a reference line. A principle use of this surveying system is for accurately aligning the electromagnets which direct a particle beam emitted from a particle accelerator. Prior art surveying systems require highly skilled surveyors. Prior art systems include, for example, optical surveying systems which are susceptible to operator reading errors, and celestial navigation-type surveying systems, with their inherent complexities. The present invention provides an automatic readout micrometer which can very accurately measure distances. The invention has a simplicity of operation which practically eliminates the possibilities of operator optical reading error, owning to the elimination of traditional optical alignments for making measurements. The invention has an extendable arm which carries a laser surveying target. The extendable arm can be continuously positioned over its entire length of travel by either a coarse of fine adjustment without having the fine adjustment outrun the coarse adjustment until a reference laser beam is centered on the target as indicated by a digital readout. The length of the micrometer can then be accurately and automatically read by a computer and compared with a standardized set of alignment measurements. Due to its construction, the micrometer eliminates any errors due to temperature changes when the system is operated within a standard operating temperature range.

21101 (EGG/LTR-LO—87-79-128) Evaluation of installed instrumentation for liquid level measurements. Adams, J.P.; Flitton, V.E.; Goodrich, L.D. (EG and G Idaho, Inc., Idaho Falls (USA)). 20 Dec 1979. Contract EY-76-C-07-1570. 53p. Dep. NTIS, PC A04/MF A01.

An evaluation is presented of the capability of several installed LOFT instruments to measure liquid level. This evaluation was accomplished by comparing thermocouples, neutron detectors, and differential pressure transducers with the LOFT liquid level transducers. A brief discussion of a heated differential thermocouple liquid level transducer is also presented.

21102 (LBL—9428) Use of film-formation models for the interpretation of ellipsometer observations. Muller, R.H.; Smith, C.G. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1979. Contract W-7405-ENG-48. 55p. (CONF-790857—2). Dep. NTIS, PC A04/MF A01.

From 4. international conference on ellipsometry; Berkeley, CA, USA (20 Aug 1979).

Mathematical film-formation models have been used for the interpretation of ellipsometer measurements of anodic films on metals. The models consider the simultaneous or sequential formation of several surface layers with time-varying properties. Mass transport between layers is modeled to take place by diffusion, migration, and convection. In experiments, mass transport is controlled and current and potential are measured simultaneously with the ellipsometer measurements. The application of continuous mass and charge balances in the models makes it possible to derive values of up to seven film parameters by fitting time-dependent ellipsometer measurements in multi-dimensional space.

21103 (PNL-SA—7737) High throughput dimensional measurements with electro-optics. Swinth, K.L.; Walker, R.A.; Nedrow, N.G. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1979. Contract EY-76-C-06-1830. 15p. (CONF-790838—5). Dep. NTIS, PC A02/MF A01.

From 23. annual international symposium of the Society of Photographic Instrumentation Engineers; San Diego, CA, USA (27 Aug 1979).

A dimensional measuring system, the profile monitor, has been developed to measure part dimensions with a standard deviation of 0.0001 inch at a throughput rate of 1200 parts/minute. The monitor is one measurement system on an advanced high speed inspection system designed to monitor the production of cartridge cases. The complete system includes a mechanical handler, measurement instruments (which make five measurements), system monitoring instruments and a dedicated minicomputer. This paper describes the profile monitor and its performance. The profile monitor is an electro-optic system that utilizes fiber optics to project an image of the case onto charged-coupled device image sensors. Measurements are made for five different case dimensions: (1) head thickness, (2) head diameter, (3) extractor groove diameter, (4) gas seal length, and (5) total length. The profile monitor consists of five major elements: the case gauging fixture, the optical system including an illumination source and computer. Electronics consist of the diode array and driver, thresholding circuit, measurement timing logic and data buffers. The square image conduit (six micron fibers) is structured to take the edges of the projected case image and transfer the image to a 0.125 inch linear charge coupled device (CCD) sensor. Logic is employed to detect the shadowed edges of the case and count the number of elements darkened by the shadow.

21104 Magnetic thin-film split-domain current sensor-recorder. Hsieh, E.J. (to Dept. of Energy). US Patent 4,180,775. 25 Dec 1979. Filed date 16 Mar 1977. 8p.

PAT-APPL-778,275.

A sensor-recorder for recording a representation of the direction and peak amplitude of a transient current. A magnetic thin film is coated on a glass substrate under the influence of a magnetic field so that the finished film is magnetically uniaxial and anisotropic. The film is split into two oppositely magnetized contiguous domains with a central boundary by subjecting adjacent portions of the film simultaneously to magnetic fields that are opposed 180°. With the split-domain sensor-recorder placed with the film plane and domain boundary either perpendicular or parallel to the expected conductive path of a transient current, the occurrence of the transient causes switching of a portion of one domain to the direction of the other domain. The amount of the switched domain portion is indicative of the amplitude of the peak current of the transient, while the particular domain that is switched is indicative of the direction of the current. The resulting domain patterns may be read with a passive magnetic tape viewer. 12 claims.

21105 Coaxial cavity for measuring level of liquid in a container. Booman, G.L.; Phelps, F.R. (to Dept. of Energy). US Patent 4,170,135. 9 Oct 1979. Filed date 26 Sep 1978. 8p.

PAT-APPL-945,926.

A method and means for measuring the level of a liquid in a container are described. A coaxial cavity having a perforated outer conductor is partially submerged in the liquid in the container wherein the liquid enters and terminates the annular region of the coaxial cavity. The fundamental resonant frequency of the portion of the coaxial cavity which does not contain liquid is determined experimentally and is used to calculate the length of the liquid-free

portion of the coaxial cavity and thereby the level of liquid in the container. 15 claims.

21106 Apparatus and method for monitoring the presence of a conductive media. DuVall, B.W.; Valentine, J.W.; Morey, K.O. (to Dept. of Energy). US Patent 4,164,146. 14 Aug 1979. Filed date 2 Nov 1976. 10p.
PAT-APPL-738,180.

An inductive level sensor is described which has inductively coupled primary and secondary windings. Circuitry drives the primary with an ac signal of constant current magnitude and selected frequency f to induce in the secondary, a voltage signal V of magnitude /V/, frequency f and phase difference phi from the driving signal. Circuitry operates to generate a voltage output signal proportional to /V/ cos (phi-θ), where θ is a selectively set phase shift factor. By properly and selectively adjusting the frequency f and phase shift factor θ, an output signal /V/ cos (phi-θ) can be provided which self-compensates for changes in mutual inductance caused by operating temperature variations so that an output signal is produced which is substantially linearly proportional to changes in the level of a pool of liquid metal being monitored. Calibration circuitry and circuitry for converting the voltage signal /V/ cos (phi-θ) into a current signal are included. 12 claims.

21107 High speed CAMAC differential branch highway driver. McMillan, D.E.; Nelson, R.O.; Poore, R.V.; Sunier, J.W.; Ross, J.J. (Los Alamos Sci Lab, NM). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 4, 4450-4453(Aug 1979).

A new CAMAC branch driver is described that incorporates several unusual features which combine to give reliable, high-speed performance. These include balanced line driver/receivers, stored CAMAC command lists, 8 DMA channels, pseudo LAMS, hardware-priority encoding of LAMS and hardware implemented Q-controlled block transfers.

21108 Summary of IEEE Computer Standards Committee activities. Gustavson, D.B. (Stanford Linear Accel Cent, Calif). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 4, 4468-4472(Aug 1979).

The current status of standardization efforts proceeding under the IEEE Computer Standards Committee of the IEEE Computer Society is summarized as of May 1979.

21109 Support of multiple data streams in a dynamically configured software system. Kulaga, J.E.; Tippie, J.W. (Argonne Natl Lab, Ill). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 4, 4489-4493(Aug 1979).

A discussion is presented of a modular data-acquisition system that allows on-line, dynamic configuration of software to meet a user's particular acquisition and analysis needs. The support of multiple data streams, typically consisting of a raw data stream and one or more derived data streams, is emphasized. Examples are given, including a real-time data transformation of multiparameter events that operates in a two-parameter data space.

21110 Design considerations for a multiprocessor based data acquisition system. Tippie, J.W.; Kulaga, J.E. (Argonne Natl Lab, Ill). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 4, 4548-4551(Aug 1979).

The rapid advance of digital technology has provided the systems designer with many new design options. Hardware is no longer the controlling expense. Complex operating systems provide the flexibility and development tools needed by software designers, but restrict throughput. Multiprocessor-based systems can be used to "front-end" high-throughput applications while maintaining the many advantages offered by multitasking operating systems. The design of a high-throughput data acquisition system for application in low energy nuclear physics is considered.

21111 Niels Bohr Institute on line data acquisition system. Neiman, M. (Niels Bohr Inst, Roskilde, Den). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 4, 4552-4553(Aug 1979).

A multiple computer data acquisition system is described. The use of multiple central processors, distributed intelligence in a CAMAC system, and large external memories is illustrated.

21112 Front-end data processing using the bit-sliced microprocessor. Machen, D.R. (Univ of Calif, Los Alamos, NM). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 4, 4618-4622(Aug 1979).

A state-of-the-art computing device, based upon the high-speed bit-sliced microprocessor, has been developed into hardware for front-end data processing in both control and experiment applications at the Los Alamos Scientific Laboratory. The CAMAC Instrumentation Standard provides the framework for the high-speed hardware, allowing data acquisition and processing to take place at the data source in a CAMAC crate.

21113 Data acquisition using PDP-11 and MBD branch driver at L.B.L. Harvey, E.H. Jr. (Univ of Calif, Lawrence Berkeley Lab). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 4, 4633-4635(Aug 1979).

A data acquisition system has been designed and preliminary versions have been implemented for physics experiments at LBL. It utilizes an MBD microprogrammed branch driver and a PDP-11 operating under RSM-11M. An MBD executive is used to implement software breakpoints within the MBD. The PDP-11 data acquisition buffer management scheme allows for multiple tasks dynamically accessing the data stream. Emphasis is directed towards future expansions. High data rates are also emphasized.

21114 CAMAC module for testing data acquisition systems. Martin, R.G.; Bays, L.A.; Taff, L.M. (Fermi Natl Accel Lab, Batavia, Ill). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 4, 4636-4640(Aug 1979).

A CAMAC module is described with self-contained hardware to test most aspects of CAMAC-based data acquisition systems. There is a 1 Hz - 5 MHz pulse generator and a simulator for an accelerator beam spill; these are ANDed with an optional inhibit signal input to produce an "event-present" output for generating a computer interrupt. The interrupt may be generated in either non-CAMAC hardware, or in standard LAM logic within the module. There is also a register which may be repeatedly written or read (to simulate data) in response to the interrupt, and, for measuring performance, there are two visual readout scalers with front-panel controls.

21115 (DOE-tr—116) Permanent magnet probe-type flowmeter for liquid metal. Mueller, S.; Thun, G. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorbauelemente). Aug 1979. Translation of KFK—2479, November 1977. 57p. Dep. NTIS (US Sales Only), PC A04/MF A01.

Work performed under United States-W. Germany Fast Reactor Exchange Program.

Details of the design and operation of an unique liquid metal flow meter probe are presented. Small permanent magnets are employed in the device. Flow rate measurements involve a determination of the transit time for natural velocity fluctuations using a double-magnet con-configuration. Experiments have shown that the used AlNiCo 450-permanent-magnets performed successfully for long times (10,000 h) at elevated temperatures (600°C). Flow meters have been employed in different test loops. They will be installed also in the BR2- and KNK II-reactors. The performance of a miniature probe (2 mm phi) and application of the device for the determination of the void fraction in a Na-inert gas stream are also presented.

21116 High-resolution, cryogenic, side-entry type specimen stage. King, W.E.; Merkle, K.L. (to Dept. of Energy). US Patent 4,162,401. 24 Jul 1979. Filed date 17 May 1978. 6p.
PAT-APPL-906,816.

A high-resolution, cryogenic side-entry type specimen stage includes a copper block within which a specimen can be positioned in the electron beam of an electron microscope. One end of the copper block constituting a specimen heat exchanger, means for directing a flow of helium at cryogenic temperature into the heat exchanger, and electrical leads running from the specimen to the exterior of the microscope for four point dc electrical resistivity measurements. 9 claims.

21117 All-reflective optical target illumination system with high numerical aperture. Thomas, C.E.; Sigler, R.D.; Hoeger, J.G. (to Dept. of Energy). US Patent 4,161,351. 17 Jul 1979. Filed date 7 May 1976. 6p.
PAT-APPL-684,095.

An all-reflective optical system is described for providing illumination of a target focal region at high numerical aperture from a pair of confluent collimated light beams. The collimated beams are each incident upon an associated concave eccentric pupil paraboloidal reflective surface. Each beam is focused through an opening in an associated outer ellipsoidal reflective surface onto a plane reflector. Each beam is reflected by its associated plane reflector onto the opposing concave surface of the outer ellipsoids to be focused through an opening in the plane surface onto an opposing inner concave ellipsoidal reflective surface, and thence onto the target region. 10 claims.

EXPLOSIONS AND EXPLOSIVES

CHEMICAL

21118 (MHSMP—80-06) Characterization of the NOL small scale gap test as performed at Pantex Plant. West, G.T.; Demerson, E.L. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)). 1980. Contract EY-76-C-04-0487. 25p. Dep. NTIS, PC A02/MF A01.

The NOL Small Scale Gap Test as performed at Pantex was characterized by determining transit times of the RP-2 detonator, the RDX donor, the plexiglas attenuator (six thicknesses were tested)

and HNS acceptors of varying type and density. Pressures in the plexiglas attenuators at the output surface were also obtained. The planarity of the emerging shock wave at the RDX and the attenuator output surfaces was also measured. Two types of HNS were tested in the normal gap test procedure, each at two different densities.

21119 (SAND—78-1696) **Feasibility study of a fail-safe through bulkhead initiator.** Schwarz, A.C. (Sandia Labs., Albuquerque, NM (USA)). Mar 1980. Contract EY-76-C-04-0789. 34p. Dep. NTIS, PC A03/MF A01.

The design status of a through bulkhead initiator (TBI) is presented. The TBI design consists of a high explosive donor which when detonated transmits a shock wave through a metal bulkhead to initiate an acceptor explosive without destroying the integrity of the bulkhead. There are at least two potential applications for such a device. The combined requirements of the two applications are severe in several aspects, namely: fail-safe, small size, and controlled function time. The PETN donor output was characterized by velocity interferometer techniques. Two methods of controlling the output were demonstrated: (1) controlling the density of the donor and (2) controlling the length of the donor column (in relationship to the bulkhead thickness). The Type 304L stainless steel bulkhead was designed using a combination of experimental and analytical techniques to assure both function and integrity. The Type 304L provides a single shock rather than a multiple wave structure and exhibits high ductility. The PETN selected for the acceptor was chosen on the basis of shock sensitivity testing in which the morphology of the explosive and the wave shape of the stimulus entering the explosive played key roles. When tested with a short pulse (40 ns, rectangular), the small particle size PETN initiated at a lower pressure than did the large particle size PETN; when tested with a long pulse (280 ns, triangular), the large particle size PETN initiated at a lower pressure than did the small particle size PETN.

21120 (SAND—79-0626) **Predictions of nuisance damage and hazard from accidental explosions during Trident missile test flights.** Reed, J.W. (Sandia Labs., Albuquerque, NM (USA)). Mar 1980. Contract EY-76-C-04-0789. 87p. Dep. NTIS, PC A05/MF A01.

The damage and hazard potential of an accidental explosion of a Trident I C-4 motor near the Cape Canaveral Launch Pad 25 was assessed. Under some weather conditions, the airblast propagation could break thousands of windows in the Cape Canaveral community; in other weather conditions only a few might be broken. A weather watch was developed and operated during Trident tests to hold threatened damage and hazard down to an acceptable minimum level. Test delays, while awaiting suitable weather, averaged near the predicted 2 days per launch test.

21121 (SAND—79-1847) **Preliminary experiments using light-initiated high explosive for driving thin flyer plates.** Benham, R.A. (Sandia Labs., Albuquerque, NM (USA)). Feb 1980. Contract EY-76-C-04-0789. 36p. Dep. NTIS, PC A03/MF A01.

Light-initiated high explosive, silver acelytide - silver-nitrate (SASN), has been used to produce simulated x ray blow-off impulse loading on reentry vehicles to study the system structural response. SASN can be used to accelerate thin flyer plates to high terminal velocities which, in turn, can deliver a pressure pulse that can be tailored to the target material. This process is important for impulse tests where both structural and material response is desired. The theories used to calculate the dynamic state of the flyer plate prior to impact are summarized. Data from several experiments are presented which indicate that thin flyer plates can be properly accelerated and that there are predictive techniques available which are adequate to calculate the motion of the flyer plate. Recommendations are made for future study that must be undertaken to make the SASN flyer plate technique usable.

NUCLEAR

21122 (AD-A—071372) **Shock effects in carbonate minerals and rocks. Final report, 1 January-30 June 1978.** Vizgirda, J.; Ahrens, T.J. (California Inst. of Tech., Pasadena (USA). Seismological Lab.). 30 Jun 1978. Contract DNA001-76-C-0218. 24p. NTIS PC A02/MF A01.

The ESR spectra of Mn(++) in naturally and laboratory shocked calcite crystals and coral core samples were studied and variations in several spectral parameters were found to be correlative with shock pressure. The amount of splitting in the central transition hyperfine component peaks was observed to decrease in the upper levels of the Cactus Crater core and in core samples shocked in the laboratory to progressively higher pressures. A comparison of the splitting amplitude between the two types of samples allows pressure assignments to the Cactus core of 3.3 GPa at 8m. + or - 5m. and 2.0 GPa at 13m. + or - 5m. Unshocked coral core samples showed no splitting amplitude variation with depth. Results from coral subjected to a long duration pressure pulse in the Miser's Bluff TNT experiment are generally inconsistent. Laboratory shocked single crystal calcite showed similar decreases in hyperfine peak splitting but at pressure levels three times greater than those producing comparable coral sample spectra. The decrease in peak splitting is interpreted to reflect small increases in cation-anion distances produced by mechanical energy input during the shock process. Another parameter, the non-central to central transition peak amplitude, is observed to decrease with increasing pressure in spectra of single crystal calcite, and may provide a means of empirically correlating very low (less than 4.5 GPa) shock pressure levels in calcite.

21123 (AD-A—071502) **Pretest simulation of Event S4 HAVE HOST series. Topical report, December 1977-July 1978.** Wong, F.S.; Isenberg, J. (Weidlinger Associates, Menlo Park, CA (USA)). Jul 1978. Contract DNA001-77-C-0104. 99p. NTIS PC A05/MF A01.

This is the third phase of an effort which examines the application of dynamic finite element methods to the analysis of shelter-like structures in a nuclear environment. In Phases 1 and 2, the elastic deformation modes of the shelter structure, their sensitivity to variations in the applied airblast wave forms, and the effects of inelasticity and computer modeling were investigated. The reported phase (three) consists of applying the methodology developed to a particular case study, i.e., Event S4 of the HAVE HOST test series. Event S4 was the test of a half-scale prototype shelter using the HEST simulated attack environment. The objective of this effort was to provide pre-test analysis and prediction data for Event S4. Detailed pre-test analytical results are provided for the headworks and the shelter main body.

WEAPONRY

REFER ALSO TO CITATION(S) 21174

21124 (AD-A—071507) **Nuclear weapon effects calculations in the TACWAR code. Final report, 20 march - 20 September 1978.** Cane, J.W.; Northrop, J.A. (Systems Science and Software, Inc., Alexandria, VA (USA)). 20 Oct 1978. Contract DNA001-78-C-0221. 132p. NTIS PC A07/MF A01.

The study reviewed the accuracy of nuclear weapon effects data and algorithms used by the IDA TACWAR theater warfare simulation computer model to make damage evaluations. The report describes areas where improvements in specifying the nuclear explosion-generated effects--nuclear radiation, thermal radiation, and air blast--could be made.

21125 (AD-A—072246) **The effects of nuclear war.** (Arms Control and Disarmament Agency, Washington, DC (USA)). Apr 1979. 28p. NTIS PC A03/MF A01.

This report presents a summary of the effects of nuclear war. The first part of the report will deal with the effects of a single nuclear weapon, the second part will discuss the effects of general nuclear war between the United States and the Soviet Union, and finally the paper will address some of the less known but nonetheless important effects of such a war.(Author)

EXPLOSION DETECTION

REFER ALSO TO CITATION(S) 21364, 21365

21126 (AD-A—072433) **Seismic source functions and attenuation from local and teleseismic observations of the NTS Events Jorum and Handley. Quarterly technical report, 22 November 1978-31 January 1979.** Hadley, D.M. (Sierra Geophysics, Inc., Arcadia, CA (USA)). 8 Mar 1979. Contract F08606-79-C-0009,. 42p. NTIS PC A03/MF A01.

This technical report discusses the determination of an accurate source description for Jorum and the results are extended to the teleseismic observations of Handley. The basic data set used to model the source are the strong motion accelerograms collected by Peppin (1964) at a distance of 8 kilometers from the test. At this distance the initial seismic energy represents diving rays and the observations are suitable for comparison with more distant regional and teleseismic observations. Using a modified Von Seggern and Blandford (1972) source representation, and including near-field terms, it has been possible to obtain a source function which not only acurately models the close-in records but alo matches teleseismic observations. After defining the near-field explosion source description, a t^* for teleseismic observations is calculated. For WWSSN short and long period observations of these events, we obtain an average t^* of about 1.3 for compressional waves with a scatter of about plus or minus 0.2. There are systematic azimuthal trends in the observed t^* values which are not strongly correlated with the Silent Canyon caldera but may be correlated with upper mantle structure northeast of NTS. These data do not rule out systematic receiver function bias as the cause of the amplitude variations.

21127 (AD-A—072844) **Propagation of LG seismic waves in the Soviet Union. Interim report.** Shishkevish, C. (RAND Corp., Santa Monica, CA (USA)). Feb 1979. Contract MDA903-78-C-0189,. 76p. NTIS, PC A05/MF A01.

This report summarizes the data on the Lg phase, a seismic wave-train with periods between 0.5 and 6 sec transmitted in the continental crust with a group velocity of 3.44 to 3.57 km/sec, propagating in the Soviet Union and nearby areas. Amplitude-distance curves and amplitude-distance correction factor data used in determining the magnitudes of Lg are given. The available travel time data, including the standard travel times of Lg, are summarized. Analysis of the efficiency of propagation of Lg by Soviet seismologists shows that Lg propagates efficiently across the Indian shield, Tarim basin, and the Russian, Siberian, and Kazakh platforms. It propagates less efficiently along Tien Shan and the Himalayas. The Tibetan platform, central part of the Black Sea, and central and eastern parts of the Caspian Sea completely eliminate Lg. 62 pp.

21128 (AD-A—072848) **Vela network evaluation and automatic processing research. Final report 1 Dec 1977-30 Oct 1978.** Sax, R.L. (Texas Instruments, Inc., Dallas (USA)). 22 Nov 1978. Contract F08606-77-C-0004,. 48p. NTIS, PC A03/MF A01.

The second part of the work performed covered as follows: Evaluated SRO and ASRO stations by expanding the data base of operational stations to include at least one calendar year of data to determine the detection and discrimination capability of the stations, and to determine the performance characteristics of the detector used at the stations. Performed research on signal detection by investigating techniques to reduce the false alarms of detectors at a constant signal detection threshold, by integrating and testing long-period signal extraction algorithms. Defined an event identification package with a set of identification criteria applied to a network of station data, determined an optimum combination of the various criteria, tested the package on an area of interest data base provided by the government, and recommended further improvements based on operational difficulties and deficiencies discovered during the study.

21129 (AD-A—073134) **Special data collection systems (Project T/4703). Semiannual report Oct 1978-Mar 1979.** Sherwin, J.R.; Kraus, G.C. (Teledyne Geotech, Garland, TX (USA)). 15 May 1979. Contract F08606-78-C-0011,. 27p. NTIS, PC A03/MF A01.

The work performed under Project T/4703, Special Data Collection Systems, during the period from October 1978 through March 1979 is described. The present program is an extension of the program which began in 1973 under Contract F08606-74-C-0013. At the start of this period, one SDCS unit remained in operation at a site near Rio Blanco, Colorado. Also, three systems were being set up at Oak Springs Butte, Nevada; Rulison, Colorado; and Battle Mountain, Nevada; these systems began operations by late October. These four systems were configured to record three-component short-period data on both digital (primary) and analog (secondary) tape recording systems; the Battle Mountain site also recorded three-component long-period data. The primary purpose of these operations was to gather data at or near the sites of prior underground explosions. These data were analyzed at the Seismic Data Analysis Center in Alexandria, Virginia, to determine the characteristics of incoming teleseismic signals and to thereby gain insight into the effects of local geology on the explosion-generated signals and other problems related to the detection and identification of underground nuclear explosions. Operations at these four site continued with only routine problems until late March when all units were shut down. Equipment was to be returned to Garland, Texas, for refurbishing and storage in preparation for later (but unspecified) deployments.

ENVIRONMENTAL SCIENCES, ATMOSPHERIC

BASIC STUDIES

REFER ALSO TO CITATION(S) 20901, 20902, 21182

21130 (ANL—78-65(Pt.3), pp 21-23) **Rainfall acidity at Argonne.** Irving, P.M. 1978.

In Radiological and Environmental Research Division: ecology. Annual report, January-December 1978.

Results of studies undertaken to characterize the chemical properties of the natural precipitation of the Midwest are reported. Rain samples from 100 precipitation events were collected at Argonne National Laboratory from April through October in 1977 and April through September in 1978 and during July and August 1978 at the sulfur dioxide-acid precipitation field investigation site about 26 miles southwest of Argonne. During the two years of collection, the pH of individual rains varied from 3.25 to 7.20. In 1977, the weighted calculated pH value obtained by averaging the hydrogen ion concentrations of samples precipitation (322 mm rain), was 4.13, while in 1978 a total of 474 mm of rain had a calculated pH value of 4.09. Monthly pH values were lower in the spring and early summer. Sulfate concentrations of the precipitation samples varied from 7 to 154 μmol/liter with a precipitation weighted average of 43, and were significantly correlated ($p \leq 0.01$) with hydrogen ion concentrations ($r = 0.434$). The lack of a high degree of correlation between hydrogen ion concentration and sulfate concentrations suggests the importance of the contribution of nitrates and ammonia to the acidity of precipitation. To further characterize the chemical composition of the precipitation samples, which may contain both fully dissociated strong acids and incompletely dissociated weak acids, acid/base titrations were performed. The results of this study indicate that precipication in the Midwest is acidic and that the low pH values are due to the pesence of strong acids.

21131 (ANL—78-65(Pt.3), pp 82-87) **Preliminary eddy-correlation measurements of momentum, heat and particle fluxes to Lake Michigan.** Williams, R.M.; Wesely, M.L.; Hicks, B.B. 1978.

In Radiological and Environmental Research Division: ecology. Annual report, January-December 1978.

A preliminary set of momentum, heat and particle flux measurements were made from a tower located 10 km offshore in southwestern Lake Michigan near Chicago. The measurements utilize the eddy-correlation technique that uses rapid response instrumentation to measure turbulent fluctuations of horizontal and vertical wind velocity, temperature, humidity, local concentrations of particles, or any other contaminants of interest.

21132 (CONF-790468—2) **Flexible role for simulation modeling in environmental decisions: models of the global carbon cycle as an example.** Emanuel, W.R. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 21p. Dep. NTIS, PC A02/MF A01.

From Institute of ecology workshop on information needs in environmental assessment; Indianapolis, IN, USA (8 Apr 1979).

The progression of models developed to analyze the global carbon cycle in resolving the CO_2/climate issue serves as an example of the changing character of models, depending on the immediate role they play in environmental decision making. The dominant and successful role served by models in the carbon cycle problem demonstrates to some degree the desirability of this flexible approach. The pattern of model development will be different for each application of modeling to environmental decision making; however, some general simularities frequently emerge. Simple models, heavily based in measurements, are often the most useful in assisting decision makers to establish priorities among a set of environmental issues. When the decision to allocate resources to the analysis of an environmental problem has been reached, structurally detailed models which are not necessarily sophisticated in the representation of each process are useful in establishing the relative importance of system interactions. Models in which structure is condensed but sophistication in representing processes is emphasized are used in actually developing policy. Finally, the design of management practices to mitigate an environmental impact requires the most complex models which usually can only be developed when the insight from earlier stages of analysis has been gained.

21133 (CONF-791031—2) **Map pattern classification at a prescribed level of generality.** Blasing, T.J. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 20p. Dep. NTIS, PC A02/MF A01.

From 6. conference on probability and statistics in atmospheric sciences; Banff, Alberta, Canada (9 Oct 1979).

Studies are reported on the development of a new map pattern correlation technique, to be applied to the analysis of Northern Hemisphere winter sea-level pressure anomaly patterns, and, where possible, the results are compared with those of principal component analysis of the same data. The map pattern recognition presented is in many ways comparable to the method of principal component eigenvectors. The pattern correlation method has several advantages over principal component eigenvectors.

21134 (CONF-800327—4) **Comparison of observed and predicted normalized air concentrations for 56-m releases of fluorescein particles.** Miller, C.W.; Little, C.A.; Cotter, S.J. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 17p. Dep. NTIS, PC A02/MF A01.

From 2. joint conference on applications of air pollution meteorology; New Orleans, LA, USA (24 Mar 1980).

Centerline ground-level normalized air concentration measurements made at Hanford, Washington, for the short-term release of fluorescein particles from a height of 56 m were compared with a Gaussian plume atmospheric dispersion model using two different sets of dispersion parameters and two different methods of classifying atmospheric stability. The ratio of the predicted air concentration to the observed air concentration is strongly dependent on the downwind distance being considered. All four methods have a

tendency to underpredict near the source, sometimes by many orders of magnitude, and to overpredict at the farthest distances considered (12.8 km). Such a tendency must be taken into account when assessing the impact (on man) of short-term pollutant releases to the atmosphere. In general, the results of this study highlight the difficulty of choosing a set of dispersion parameters and estimating atmospheric stability for use in assessment activities. These results also show, however, that such specification is important in determining the accuracy of Gaussian plume atmospheric dispersion model predictions.

21135 (ORNL/EIS—160) **Interlaboratory evaluation of microcosm research: proceedings of the workshop, Athens, Georgia, September 18-19, 1979.** Haque, R.; Nabholz, J.V.; Ryon, M.G. (eds.). (Oak Ridge National Lab., TN (USA); Environmental Protection Agency, Washington, DC (USA)). Apr 1980. Contract W-7405-ENG-26. 30p. (EPA—600/9-80-019). Dep. NTIS, PC E03/MF E03.

This workshop, held at Athens, Georgia, September 18-19, 1979, was to aid the Office of Environmental Processes and Effects Research (OEPER) in evaluating and integrating microcosm research in the OEPER environmental research laboratories. Participants discussed the design, advantages, and limitations of microcosms; the value and potential role of microcosms in the regulatory decision-making process; the identification of priority and long-term research needs to refine microcosm methodology as a data source for hazard and risk assessments; and the creation of a microcosm technology committee to assist OEPER in coordinating and integrating microcosm research. These proceedings consist of recommendations made by special task groups on each of the major topics discussed.

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 19991, 19997, 19999, 20043, 20196, 20833, 20834, 21184, 21199, 21207, 21339, 21341, 21342, 21346, 21358

21136 (AD-A—072912) **Investigation of hazards posed by chemical vapors released in marine operations. phase i. Final report Aug 1977-May 1979.** Astleford, W.J.; Morrow, T.B.; Magott, R.J.; Bass, R.L. (Southwest Research Inst., San Antonio, TX (USA)). 15 May 1979. Contract DOT-CG-70363-A. 352p. NTIS, PC A16/MF A01.

The flammability and toxicity hazards associated with (1) emission of chemical vapors from tankers and barges during product loading in a marine terminal and (2) man-entry into empty tanks were studied. Analytical models were developed to describe (1) the near field atmospheric dispersion of heavier-than-air vapors during tank loading and (2) the vapor concentrations in an empty tank during ventilation and evaporation of residual chemicals. Sensitivity analyses were performed on the models to identify the important independent variables. These models and their sensitivity analyses guided the planning and execution of laboratory and full scale experiments. Two full scale tests were conducted. During these tests, a vapor sampling and analysis program was conducted to measure (1) the source concentration-time histories of vapors vented from tanks during loading, (2) deck crew vapor exposures during tank loading as well as during entry into empty tanks, and (3) downwind and lateral plume dispersion. Experimental data are compared with analytical model predictions. The requirements for an expanded model validation test program were also developed.

21137 (ANL—78-65(Pt.3), pp 88-91) **Development of a battery operated data acquisition system for atmospheric and limnological research.** Williams, R.M.; Haumann, J.R.; White, R.V. 1978.

In Radiological and Environmental Research Division: ecology. Annual report, January-December 1978.

In assessing the needs for pollutant transport studies in the Great Lakes Research Program is was evident that an automatic data acquisition system for remote operation was required. Evaluation of the atmospheric input contribution to Great Lakes pollutants requires long-term, relatively frequent measurements of meteorological from stations located over the open lake; investigating the physics of sediment resuspension at the sediment water interface has higher frequency, shorter-term requirements. The overlapping data acquisition requirements of these two tasks defined a set of specifications for a remote data acquisition system. The basic requirements were: (1) capacity: 32 channels; (2) resolution: 12 bits (1 part of 4096); (3) sample rate: 41 hr to 0.050 sec (0.02 sample hr^{-1} to 20 sample sec^{-1} per channel); (4) operation modes: continuous, burst and conditional; (5) record mode: instantaneous and mean; (6) duration: $>$ 2 weeks or until the cassette is full. To meet these requirements a battery powered system was developed that utilizes microprocessor analog and digital circuitry to reduce power consumption and microprocessor capability to achieve flexibility. The system consists of three packages: the analog sensors, the battery pack, and the data acquisition system. The system and its operation are described.

21138 (ANL—78-65(Pt.3), pp 92-95) **Preliminary findings of wind-direction controlled aerosol sampling over Lake Michigan.** Williams, R.M.; Muhlbaier, J. 1978.

In Radiological and Environmental Research Division: ecology. Annual report, January-December 1978.

A wind-direction controlled aerosol sampling system consisting of three Hi-Volume air samples has been operated at Chicago's 68th Street water intake facility (4 km offshore) since August 1978. Wind sectors selected were: A (135° to 180°), B (200° to 270°), and C (345° to 070°); these sample air from Gary-Indiana Harbor, Chicago, and open-lake areas, respectively. Filters are initially analyzed for inorganic trace elements by x-ray fluorescence; elements present at very low concentrations, such as cadmium, are subsequently analyzed by atomic absorption. In 1978 approximately 50 filters were analyzed for Fe, Pb, Mn, Zn, Br, Se, and Cd. Results of these initial studies are given in terms of monthly averages for each sector for the five months since sampling commenced. The results clearly indicate that the air from sector A (i.e., from the Gary-Indiana Harbor area) is the most polluted, except for the automobile exhaust-related pollutants Pb and Br, which are high in the air from Chicago (Sector B). As expected, air which are high in the air from Chicago (Sector B). As expected, air which has blown over a long fetch of open lake from the NNE (Sector C) is very clean. Enrichment factors relative to crustal abundance were also calculated using Fe as the reference element. Mn showed no enrichment, thus indicating a crustal source; Zn, Pb, Br, Se, and Cd showed respectively increasing enrichment factors as might be expected from their relative volatility and large anthropogenic sources.

21139 (ANL—78-65(Pt.3), pp 100-104) **X-ray fluorescence analysis of air filters.** Muhlbaier, J.L.; Tisue, G.T. 1978.

In Radiological and Environmental Research Division: ecology. Annual report, January-December 1978.

A procedure was developed for the analysis of trace metals on air particles by energy dispersive x-ray fluorescence. Air particles are collected on a 20 x 25 cm Whatman 541 filter using a high volume pump. A 3 cm square section of the filter is mounted between Mylar films in a 35 mm slide amount. Typical spectra from blank and exposed filters are shown. Standard curves of V, Mn, Fe, and Ln are given. Sensitivities and detection limits were computer for several elements and are tabulated. The precision of analysis is given for Mn, Fe, Zn, Br, and Pb. (JGB)

21140 (BNL—51133) **Hourly variability of sample chemistry during precipitation events and its relationship to meteorological parameters.** Raynor, G.S.; Hayes, J.V. (Brookhaven National Lab., Upton, NY (USA)). Aug 1979. Contract EY-76-C-02-0016. 18p. Dep. NTIS, PC A02/MF A01.

Data from hourly precipitation samples taken at Brookhaven National Laboratory from June 1976 to May 1979 were analyzed to determine the hourly variability within precipitation events with respect to the event means for each of the chemical measurements. These included conductivity and concentrations of hydrogen, nitrogen, sulfate, ammonium, chloride, and sodium ions. The coefficient of variation (S.D./anti X) was found for each variable in each event of three hours or more. Events were then classified by length, season, precipitation rate, and by meteorological parameters and the variability of the coefficient of variation computed for each class. Results are presented in a series of tables.

21141 (CONF-800301—5) **Aspects of environmental effects of dielectric gases.** Sauers, I.; Christophorou, L.G.; Frees, L.C.; Ellis, H.W. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 9p. Dep. NTIS, PC A02/MF A01.

From 2. international symposium on gaseous dielectrics; Knoxville, TN, USA (9 Mar 1980).

The increasing usage of dielectric gases requires studies of their environmental effects and long-range stability. Results are presented and discussed on the following aspects of the environmental effects of dielectric gases/mixtures: (i) identification, by time-of-flight mass spectrometry, of fragment negative ions resulting from collisions of low-energy electrons (0 to 12 eV) with the perfluorocarbons 2-C_4F_8, c-C_4F_8, 2-C_4F_6, c-C_4F_6, and 1,3-C_4F_6, and the chloro-fluorocarbons 1,1,1-$C_2Cl_3F_3$ and 1,1,2-$C_2Cl_3F_3$;(ii) study of the transient species produced in a high pressure discharge by quadrupole mass spectromery with special emphasis on SF_6 breakdown; (iii) analyses of the final stable breakdown products of the gases 2-C_4F_8 and c-C_4F_8 and the gas mixtures 2-C_4F_8/SF_6, 2-C_4F_8/N_2 and c-C_4F_8/SF_6 for varying concentrations of perfluorocarbon utilizing gas chromatography/mass spectrometry; (iv) study of the effects of prolonged electrical stress on gas dielectrics; and (v) evaluation of the toxicity of some new gaseous dielectrics.

21142 (CONF-800443—1) **Formaldehyde monitoring program: development of sampling and analysis procedures.** Matthews, T.G.; Hawthorne, A.R. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 9p. Dep. NTIS, PC A02/MF A01.

From Consumer Product Safety Commission symposium concerning formaldehyde; Washington, DC, USA (11 Apr 1980).

This report outlines the scope and goals of the formaldehyde analysis program being carried out in Health and Safety Research Division of the Oak Ridge National Laboratory under contract of the US Consumer Product Safety Commission. The outline of the sampling and analysis techniques under consideration, with reference to a time frame for developmental work and field application, is discussed. The complexity of the different techniques is addressed in instances where technical staff would be requird for accurate operation of the instrumentation.

21143 (DOE/EV/10206—1) **Geochemical determination of biospheric CO_2 fluxes to the atmosphere. Annual progress report.** Stuiver, M. (Washington Univ., Seattle (USA)). 27 Feb 1980. Contract AT06-79EV10206. 4p. Dep. NTIS, PC A02/MF A01.

A research program has been initiated to increase the knowledge of past biospheric carbon reservoir changes that have resulted in increases, or reductions, of atmospheric CO_2 levels. The research program was approved in July 1979. This progress report covers 7 months of work. The research has been mainly developmental; initial steps taken in measurements of $^{13}C/^{12}C$ ratios in tree rings are summarized briefly.

21144 (DP-MS—79-72) **Effect of vegetation on air quality: the value of forest vegetation as a filter for industrial sources of air pollutants.** Murphy, C.E. Jr.; Ares, J.O. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.; Aluar Alumino Agentino, Madryn (Argentina)). 1980. Contract EY-76-C-09-0001. 6p. (CONF-800327—5). Dep. NTIS, PC A02/MF A01.

From 2. joint conference on applications of air pollution meteorology; New Orleans, LA, USA (24 Mar 1980).

A general model that can be used to estimate the deposition of gaseous pollutants by forests is made with described. Then the model is used to estimate the deposition of fluoride as hydrogen fluoride (HF) around an aluminum refinery. A comparison of spatial and temporal concentration patterns is made with data collected around the ALUAR plant in Puerto Madryn, Argentina. Finally, the area of forest needed to remove a significant portion of the fluoride from the atmosphere is estimated.

21145 (DP-MS—80-30) **Particle mass concentration and size distribution determination in the TNX melter pilot plant.** Feigley, C.E. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1980. Contract EY-76-C-09-0001. 12p. Dep. NTIS, PC A02/MF A01.

The purpose of this report is to make recommendations concerning the techniques and instrumentation for measuring particle mass concentration and size distribution in various process streams of the E.I. DuPont TNX melter pilot plant. The approach was to evaluate alternative instrumentation and to recommend those which are reasonably accurate and which will present fewest maintenance, calibration and sampling problems for a particular application. It should be understood that in recommending a particular instrument, this consultant in no way assumes any liability for the operation of performance of that instrument.

21146 (EPA—450/4-79-016(Draft)) **Guideline for fluid modeling of atmospheric diffusion.** Snyder, W.H. (Environmental Protection Agency, Research Triangle Park, NC (USA)). Jun 1979. 185p. Environmental Protection Agency, Research Triangle Park, NC.

It is essential to be able to describe and predict the transport and diffusion of pollutants in the atmosphere. Present mathematical models are not yet adequate for calculating concentrations of contaminants when the plume is affected by obstructions such as hills and buildings. Field programs to obtain adequate data are very expensive and time consuming. Small scale models immersed in the flow of wind tunnels and water channels, i.e., fluid models, can frequently be of use in simulating atmospheric transport and diffusion in a timely and relatively inexpensive manner. It is the aim of this guideline to point out the capabilities and limitations of fluid modeling and to recommend standards to be followed in the conduct of such studies. The fundamental principles of fluid modeling are well-established, but when decisions must be made concerning a particular model study, the fundamental principles frequently do not provide specific guidance. There is a need for basic and systematic modeling studies to provide more specific guidance.

21147 (IVL-B—506) **Report from the workshop ozone effects on vegetation in Europe.** Eastmond, M.; Skaerby, L. (Swedish Water and Air Pollution Research Lab., Goeteborg). Jul 1979. 54p. (CONF-7904128—). Dep. NTIS, PC A04/MF A01.

From Ozone effects on vegetation in Europe workshop; Goteborg, Sweden (18 Apr 1979).

A meeting of scientists from different European countries was held to discuss the problems concerning effects of ozone on vegetation. Primarily the workshop was intended to review the present state of biological research related to ozone in Europe. It was also aimed at enhancing cross-national and inter-disciplinary (chemists-biologists) contacts between researchers in the field and to open possibilities of co-ordinating research and monitoring programs. After the presentation of papers and working group discussions the meeting concluded that greater European co-operation in this field was necessary and agreed to begin with the standardization of methods used for the cultivation of tobacco as indicator plants, in parallel with current atmospheric chemical monitoring programs. As ozone levels can be expected to rise considerably in the near future, intensified research and field observation of effects of ozone on cultivated and natural vegetation is imperative.

21148 (LA-UR—80-754) **Sulfur dioxide emissions from primary copper smelters in the western US.** Mangeng, C.A.; Mead, R.W. (Los Alamos Scientific Lab., NM (USA); New Mexico Univ., Albuquerque (USA). Dept. of Chemical and Nuclear Engineering). 1980. Contract W-7405-ENG-36. 16p. (CONF-800608—1). Dep. NTIS, PC A02/MF A01.

From Air Pollution Control Association annual meeting; Montreal, Canada (Jun 1980).

The body of information presented is directed to environmental scientists and policy makers without chemical or metallurgical engineering backgrounds. This paper addresses the problems of reducing sulfur dioxide emissions from primary copper smelters in the western United States and projects the future impact of emissions within a framework of legal, technological, and economic considerations. Methodology used to calculate historical sulfur dioxide emissions is described. Sulfur dioxide emission regulaticns are outlined as they apply to primary copper smelters. A discussion of available sulfur dioxide control technology and copper smelting processes summarizes the technological and economic problems of reducing copper smelter emissions. Based upon these technological and economic considerations, projections of smelter emissions indicate that compliance with existing legislative requirements will be achieved by 1990. Three smelters are projected to close by 1985.

21149 (PB—80-100449) **Fine particle Emissions Information System. Annual report Jan-Dec 78.** Schrag, M.P.; Reider, J.P.; Young, F.N. (Midwest Research Inst., Kansas City, MO (USA)). May 1979. Contract EPA-68-02-2641. 53p. NTIS, PC A04/MF A01.

The report is the first annual report on the Fine Particle Emissions Information Systems (FPEIS), a computerized data base on primary fine particle emissions from stationary sources. The report summarizes changes made in 1978, including the expanded reporting of chemical analysis data, the entering of confidential or proprietary data, and the development of computer software to aid users in interpreting the FPEIS data. It lists new data added to the FPEIS in 1978 and outlines objectives for 1979, including the addition of biological and radiological analysis results and the implementation of a new source categorization protocol. The FPEIS provides a centralized inventory of fine particle measurement information for researchers engaged in fine particle control technology development and in the environmental assessment of energy and industrial processes. From an initial data loading for about 50 test sites in January 1977, the FPEIS program had grown to 120 test sites and almost 2000 sampling runs by the end of December 1978.

21150 (PB—80-102353) **Plume rise study at Gallatin and Allen Steam Plants--data presentation.** Crawford, T.L.; Coleman, J.H. (Tennessee Valley Authority, Muscle Shoals, AL (USA). Office of Natural Resources). May 1979. 97p. NTIS, PC A05/MF A01.

This report makes detailed data on plume rise available for independent analysis by other specialists studying atmospheric dispersion. Techniques of data collection and methods of data reduction are detailed. Data from 32 time-averaged observations of the plumes at Gallatin and Allen Steam Plants, their sources, and the meteorological conditions are reported. Most of the data were collected during early to midmorning and are therefore characterized by stable and neutral atmospheric conditions. The data are presented in both a summary and a detailed format.

21151 (PB—80-103492) **Assessment of environmental impact of the mineral mining industry. Final report.** Greber, J.S.; Patel, V.P.; Pfetzing, E.A.; Amick, R.S.; Toftner, R.O. (PEDCO-Environmental, Inc., Cincinnati, OH (USA)). Jul 1979. Contract EPA-68-03-2479. 289p. NTIS, PC A13/MF A01.

This report presents a multimedia (air, liquid and solid wastes) environmental assessment of the domestic mineral mining industry. The primary objective of the study was to identify the major pollution problems associated with the industry. A secondary objective was to define research and development needs for adequate control of air pollutants and liquid and solid wastes connected with mineral mining. This study provides the EPA with (1) an initial data base on the type and quantity of wastes generated and the treatment and disposal techniques now applied for their control; (2) a data base for technical assistance activities; and (3) the necessary background information to implement research and development programs, to document effective pollution control techniques, and to fill gaps in the data base.

21152 (PB—80-103617) **Relationships between total suspended particulate, sulfate, and respirable suspended particulate concentra-**

tions. Analysis of data collected in New York City. Report for July 1978-June 1979. DeMarrais, G.A. (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab.). Sep 1979. 33p. NTIS, PC A03/MF A01.

Two years of data for daily total suspended particulate, sulfate, and respirable suspended particulate concentrations measured at four stations in the New York City area are statistically analyzed. To show the variability of each pollutant data set, the mean, median, and 16th and 84th percentile values of concentration of each pollutant are summarized. To demonstrate the spatial representativeness of the concentrations of individual pollutants, the daily (24-hour) concentrations at pairs of stations were compared and correlation coefficients determined. Results indicated that sulfate concentrations varied on an area-wide basis while the concentration of respirable suspended particulates at the four stations appeared to depend on local conditions.

21153 (PB—80-105562) **Environmental considerations of selected energy-conserving manufacturing process options. Volume XX: toxics/organics. Final report.** (Little (Arthur D.), Inc., Cambridge, MA (USA)). Aug 1979. Contract EPA-68-03-2198. 99p. NTIS, PC A05/MF A01.

Arthur D. Little, Inc. undertook a study of the 'Environmental Considerations of Selected Energy-Conserving Manufacturing Process Options.' Some 80 industrial process options were examined in13 industrial sectors. Results were published in 15 volumes, including a summary, industry prioritization report, and 13 industry oriented reports. The present report summarizes the information regarding toxic/organic pollutants in the 13 industry reports. Specifically, the report relates to the following: Processes and potential toxic/organic discharges--(Bases of calculations, iron and steel, petroleum refining, pulp and paper, olefins, ammonia, alumina/aluminum, textile, cement, glass, chlor-alkali, phosphorus/phosphoric acid, primary copper, and fertilizer).

21154 (PB—80-106040) **Environmental considerations of selected energy-conserving manufacturing process options. Volume XVII. Nitrogen oxides summary report. Final report.** (Little (Arthur D.), Inc., Cambridge, MA (USA)). Jul 1979. Contract EPA-68-03-2198. 90p. NTIS, PC A05/MF A01.

Arthur D. Little, Inc. undertook a study of the 'Environmental Consideration of Selected Energy-Conserving Manufacturing Process Options.' Some 80 industrial process options were examined in 13 industrial sectors. Results were published in 15 volumes, including a summary, industry prioritization report, and 13 industry oriented reports. The present report summarizes the information regarding nitrogen oxide pollutants in the 13 industry reports. Topics considered include the following: Processes and potential nitrogen oxide emissions--(Bases of calculations, NOx control methods, petroleum refining industry, cement industry, olefins industry, alumina and aluminum industry, glass industry, copper industry, fertilizer industry, ammonia, iron and steel, phosphorus/phosphoric acid, textile industry, pulp and paper industry, and chlor-alkali industry).

21155 (PB—80-106099) **Environmental considerations of selected energy-conserving manufacturing process options. Volume XVI. Sulfur oxides summary report. Final report.** (Little (Arthur D.), Inc., Cambridge, MA (USA)). Aug 1979. Contract EPA-68-03-2198. 111p. NTIS, PC A06/MF A01.

Arthur D. Little, Inc. undertook a study of the 'Environmental Considerations of Selected Energy-Conserving Manufacturing Process Options' Some 80 industrial process options were examined in 13 industrial sectors. Results were published in 15 volumes, including a summary, industry prioritization report, and 13 industry oriented reports. This present report summarizes the information regarding particulates in the 13 industry reports. Four parallel reports treat sulfur oxides, nitrogen oxides, solid residues, and toxics/organics. All of these pollutant-oriented reports are intended to be closely used with the original 15 reports.

21156 (PB—80-106107) **Environmental considerations of selected energy-conserving manufacturing process options. Volume XVIII. Particulates summary report. Final report.** (Little (Arthur D.), Inc., Cambridge, MA (USA)). Aug 1979. Contract EPA-68-03-2198. 111p. NTIS, PC A06/MF A01.

Results are published in 15 volumes, including a summary, industry prioritization report, and 13 industry oriented reports. This present report summarizes the information regarding particulates in the 13 industry reports. Four parallel reports treat sulfur oxides, nitrogen oxides, solid residues, and toxics/organics. All of these pollutant oriented reports are intended to be closely used with the original 15 reports.

21157 (PB—80-107055) **Evaluation of methodology and prototype to measure atmospheric sulfuric acid. Final report, September 1976-November 1978.** Snyder, R.E.; Tonkin, M.E.; McKissick, A.M. (Atlantic Research Corp., Alexandria, VA (USA)). Aug 1979. Contract EPA-68-02-2467. 172p. NTIS, PC A08/MF A01.

A method was developed to selectively assay ambient sulfuric acid aerosol. The method uses the vapor of a volatile amine (or amine derivative) to neutralize the acid as it is collected on a Teflon filter. The amine sulfate thus formed is thermally decomposed at 200 degrees C to release sulfur dioxide, or other stoichiometrically related sulfur containing adducts, which are measured by a flame photometric detector. Immediate chemical fixation of the acid lessens the chance of side reactions with other substances on the filter, while the relatively low decomposition temperature aids in eliminating other sulfur-containing particles. Sulfur dioxide is also collected as a reagent complex on the filter, but is selectively removed by heating at 100 degrees C.

21158 (PB—80-107162) **Validation of the caline 2 model using other data bases (type b study). Final report, December 1977-January 1979.** Benson, P.E.; Squires, B.T. (California State Dept. of Transportation, Sacramento (USA). Transportation Lab.). May 1979. 70p. NTIS, PC A04/MF A01.

New Gaussian vertical dispersion curves for the first 100 meters downwind of a freeway are proposed. The validity of assuming a vertical Gaussian distribution of pollutants near the freeway is examined. Results are given which indicate that traffic induced turbulence dominates at the point of emission, but that daytime variations in traffic flow have a negligible effect on the initial mixing of the pollutant at the source. Residence time within the 'mixing cell', as determined by ambient wind speed, controls the initial amount of mixing that occurs.

21159 (PB—80-108160) **Interpretation of environmental assessment data. Final report, March 1978-September 1979.** Sexton, N.H.; Sexton, F.W.; Southerland, L.I.; Hartwell, T.D. (Research Triangle Inst., Research Triangle Park, NC (USA)). Sep 1979. Contract EPA-68-02-2156. 242p. NTIS, PC A11/MF A01.

The report describes preliminary attempts to formulate viable models for interpreting environmental assessment data. The models are evaluated using data from the four most comprehensive environmental assessments. A format for entering environmental assessment results on FORTRAN computer sheets is presented and more complete data entry sheets, being developed by IERL-RTP are discussed. Various previously proposed models (Source Severity; Source Assessment Models SAM/I, SAM/IA, and SAM/IB) are investigated using the data from the four previously mentioned studies. Correlations between biotests and chemical results, and between biotests, were calculated using the data from these four studies; a summary of possible correlations is presented. In the study of correlations, the data are examined from each study individually and from the entire data set taken as a whole. Generally, results do not reveal a strong degree of association between the chemical analyses and the biological tests. When all factors relevant to an intelligent decision on the acceptability of a waste stream are considered, there appears to be no mathematical model that will encompass all of them. The models are useful but must still be utilized with considerable care.

21160 (PB—80-802903) **Asbestos and silicate pollution (citations from the Engineering Index data base). Report for 1970-November 1979.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Dec 1979. 189p. NTIS PC N01/MF N01.

The cited reports from a worldwide literature survey relate to detection, control, sampling, and chemical analysis of silicate and asbestos pollution in water, air, and soil. Included are a few citations on the environmental impacts of these chemicals. (This updated bibliography contains 183 abstracts, 8 of which are new entries to the previous edition.)

21161 (PB—298077) **Accuracy of remotely sensed SO2 mass emission rates. Final report, June 1976-December 1978.** Sperling, R.B.; Peache, M.A.; Vaughan, W.M. (Environmental Measurements, Inc., San Francisco, CA (USA)). May 1979. Contract EPA-68-02-2711. 62p. NTIS PC A04/MF A01.

Remote sensing data of single-stack power plant emissions and local wind speed have been analyzed to determined SO2 mass flux for comparison with EPA referenced methods. Four days of SO2 data were gathered from a moving platform by three upward-viewing remote sensors -- two ultraviolet absorption spectrometers and an infrared gas filter spectrometer. Wind velocity data were gathered by a laser-doppler velocimeter (LDV); supplemental data were obtained from a tethered balloon (telemetered) and pilot balloons (optical theodolite). The data matrix (SO2, X-Y position, wind velocity for 120 traverses) was computer processed; the end result was the SO2 mass flux derived from the remote sensing data. Comparisons were made between these SO2 fluxes (averages for 20 minutes and 60 minutes) and those derived from in-stack measurements. The results of the comparisons show the relative accuracy of the remote sensing technique for quantifying SO2 mass emission rates. The analysis shows that as averaging time increases from 20 minutes to 12 hours the difference between the remotely measured SO2 mass flux and the stack sampling SO2 mass flux decreases from about + or - 35% to + or - 10%. In general, no single wind

measuring system produced superior results over the other two. The LDV and COSPEC, however, produced the best agreement with Method 6 (+6%) when the plume was transported near the LDV instrument.

21162 (PB—298459) **Guidance for selecting TSP episode monitoring methods.** Manire, G. (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). 12 Feb 1979. 34p. NTIS PC A03/MF A01.

This guideline explains the principles of operation of the two episode particulate monitoring methods which are modification of the reference method and the procedures for establishing a site and season-specific relationship between the high volume method and particulate methods other than the modified reference methods.

21163 (PB—298578) **AEROS manual series. Volume V. AEROS manual of codes. Update number 2.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Jun 1979. 176p. NTIS PC A09.

The manual contains the following: general geographical codes; NEDS specific codes; SAROAD specific codes; SOTDAT specific codes; QAMIS specific codes; SIP specific codes; and HATREMS specific codes.

21164 (PNL—3300(Pt.3), pp 42) **Sulfur wet deposition in the northeast United States: winter 1978-1979.** Dana, M.T. Feb 1980. In Pacific Northwest Laboratory annual report for 1979. Part 3. Atmospheric sciences.

Results of an analysis of dissolved sulfur dioxide and sulfate deposition on the Multistate Atmospheric Power Production Pollution Study (MAP3S) Precipitation Chemistry Network for the winter of 1978 to 1979 are discussed. The ratios of dissolved SO_2 (SO_2/sup =/) to total sulfur (SO_2/sup =/ and SO_4/sup =/) concentrations as observed at seven of the eight MAP3S sites are given. At all sites, the dissolved SO_2 component is a significant fraction of the total sulfur in the wintertime, but the winter total sulfur concentration is only about one seventh of that occurring in the summer months. Users of sulfur deposition data should recognize that not all of the wintertime sulfur deposition is as sulfate, as has been routinely assumed in the past. (JGB)

21165 (PNL-SA—7541) **Emission source specification in a regional pollutant transport model.** McNaughton, D.J. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jun 1979. Contract EY-76-C-06-1830. 7p. (CONF-7910137—1). Dep. NTIS, PC A02/MF A01.

From WMO symposium on long-range transport of pollutants; Sophia, Bulgaria (10 Oct 1979).

A series of sensitivity and verification tests are examined to evaluate various means of emission source specification in a regional model. The regional air quality model incorporates pollutant transport, dispersion, chemical transformation, dry deposition, and precipitation scavenging of primary and secondary pollutants. It is currently under development and evaluation for sulfur oxide predictions as part of the Multistate Atmospheric Power Production Pollution Study (MAP3S). The effects of spatial averaging of emissions as would be applicable to models using gridded emissions as input are discussed. The analysis makes use of observed ambient air concentration data for sulfate and sulfur dioxide and sulfate concentrations in precipitation. Cases for study were selected from the intensive study periods of the Sulfate Regional Experiment of the Electric Power Research Institute.

21166 (PNL-SA—7546) **Comparison of the results of an eight layer regional model versus a single layer regional model for a short term assessment.** Davis, W.E. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jun 1979. Contract EY-76-C-06-1830. 9p. (CONF-7910137—2). Dep. NTIS, PC A02/MF A01.

From WMO symposium on long-range transport of pollutants; Sophia, Bulgaria (10 Oct 1979).

The results from an eight layer diabatic regional assessment model with estimates of vertical motions are compared to results from a single layer model without vertical motions for April 1974. Deposition results from the eight layer model with and without estimates of below cloud scavenging indicate that significant differences can occur in amounts deposited as well as in surface air concentrations.

21167 (UCID—18585) **Experimental plan for 40-m³ liquefied natural gas (LNG) dispersion tests.** Koopman, R.P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Mar 1980. Contract W-7405-ENG-48. 33p. Dep. NTIS, PC A03/MF A01.

An experimental team from the Lawrence Livermore Laboratory (LLL) will soon begin a series of liquefied natural gas (LNG) experiments at the Naval Weapons Center (NWC), China Lake, California. These experiments will involve spilling 40m³ of LNG onto a pond and measuring the characteristics of the gas plume as it disperses downwind. A large array of instruments has been developed to make measurements of gas concentration, temperature, humidity, wind velocity, and heat balance and to telemeter the data back to a data recording trailer. Experiments will be performed for various wind speeds and various spill rates over a five-month period.

21168 (UCRL—83287) **Department of Energy's atmospheric studies in complex terrain (ASCOT) program.** Dickerson, M.H.; Gudiksen, P.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Mar 1980. Contract W-7405-ENG-48. 6p. (CONF-800327—9). Dep. NTIS, PC A02/MF A01.

From 2. joint conference on applications of air pollution meteorology; New Orleans, LA, USA (24 Mar 1980).

The ASCOT program is designed to develop the technology needed to assess atmospheric properties and the impact of new energy sources on air quality in areas of complex terrain. The program uses theoretical atmospheric physics research, mathematical models, field experiments, and physical models to help develop a modeling and measurement methodology that can be used to provide the air quality assessments in these areas. The two objectives of the ASCOT program are: to improve fundamental knowledge of transport and dispersion processes in complex terrain; and building on this improvement in the understanding of the physics, provide a methodology for performing air quality assessments. To initiate the program, each participating laboratory and university was asked to redirect certain funds into a focused area of research involving atmospheric boundary layer flow, which is subject to interactions with complicated underlying terrain. This presentation provides a general overview of the ASCOT program's major activities and future goals.

21169 **Precipitation acidity: the role of the forest canopy in acid exchange.** Hoffman, W.A. Jr.; Lindberg, S.E.; Turner, R.R. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *J. Environ. Qual.;* 9: No. 1, 95-100(Jan 1980).

Individual rain events were sampled above and below the forest canopy in Walker Branch Watershed, Tennessee, from August 1977 to June 1978 for the purpose of analysis of acidity and organic content. Strong acid content correlated with sulfate concentrations. Total acid concentrations were conserved as rain penetrated chestnut oak (Quercus prinus L.) canopies, although the strong/weak acid ratio declined substantially. Although weak acids constituted at least 30% of the total acidity of incident rain and increased to over 50% in throughfall, the increase could not be entirely attributed to organic acids. The results of the study support the fundamental importance of ion-exchange models in systematizing rain-vegetation interactions.

21170 **Isokinetic air sampler.** Sehmel, G.A. (to Dept. of Energy). US Patent 4,159,635. 3 Jul 1979. Filed date 24 Aug 1978. 4p.

PAT-APPL-936,461.

An isokinetic air sampler includes a filter, a holder for the filter, an air pump for drawing air through the filter at a fixed, predetermined rate, an inlet assembly for the sampler having an inlet opening therein of a size such that isokinetic air sampling is obtained at a particular wind speed, a closure for the inlet opening and means for simultaneously opening the closure and turning on the air pump when the wind speed is such that isokinetic air sampling is obtained. A system incorporating a plurality of such samplers provided the air pumps set to draw air through the filter at the same fixed, predetermined rate and having different inlet opening sizes for use at different wind speeds is included within the ambit of the present invention as is a method of sampling air to measure airborne concentrations of particulate pollutants as a function of wind speed.

21171 **Formation of sulfate, ammonium and nitrate in an oil-fired power plant plume.** Forrest, J.; Garber, R.; Newman, L. (US Brookhaven Natl Lab, NY). *Atmos. Environ.;* 13: No. 9, 1287-1297(1979).

The plume from Florida oil-fired power plant without particulate controls was monitored to determine whether the high particulate emissions could yield an elevated conversion rate of plume sulfur dioxide distinct from primary sulfate production. The relationship between plume SO4 formation and excess oxygen during combustion was investigated also. Downwind plume samples taken during various plant operational oxygen levels indicated that particulate SO4 and sulfuric acid concentrations in both flue gas and plumes increased directly with excess oxygen levels. Plume dropout of particulate SO4 sometimes occurred. Other experimental observations are recorded. (3 graphs, 29 references, 9 tables)

21172 **Aerosol beams.** Dahneke, B. (Univ. of Rochester, NY). pp 187-223 of Recent development in aerosol science. Shaw, D.T. (ed.). New York, NY; John Wiley and Sons, Incorporated (1978).

An aerosol beam is generated when an aerosol expands through an orifice, capillary, or nozzle into an evacuated chamber. The properties and applications of aerosol beams are discussed. Topics discussed include: particle velocities; size separation of particles; detection and measurement of particles; sample collection; electric charging of particles; errors in particle counting. (ACR)

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 20196, 20202, 21184, 21284

21173 (CONF-800427—3) **Estimated radiation dose from timepieces containing tritium.** McDowell-Boyer, L.M. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 23p. Dep. NTIS, PC A02/MF A01.

From Tritium technology in fission, fusion, and isotopic application; Dayton, OH, USA (29 Apr 1980).

Luminescent timepieces containing radioactive tritium, either in elemental form or incorporated into paint, are available to the general public. The purpose of this study was to estimate potential radiation dose commitments received by the public annually as a result of exposure to tritium which may escape from the timepieces during their distribution, use, repair, and disposal. Much uncertainty is associated with final dose estimates due to limitations of empirical data from which exposure parameters were derived. Maximum individual dose estimates were generally less than 3 μSv/yr, but ranged up to 2 mSv under worst-case conditions postulated. Estimated annual collective (population) doses were less than 5 person/Sv per million timepieces distributed.

21174 (DOE/NV/00410—58) **Operation QUICKSILVER. Onsite radiological safety report, October 1978-September 1979.** Mullen, O.W.; Eubank, B.F. (Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (USA)). Feb 1980. Contract EY-76-C-08-0410. 30p. Dep. NTIS, PC A05/MF A01.

QUICKSILVER was the name assigned to the series of underground nuclear experiments conducted at the Nevada Test Site from October 1, 1978 to September 30, 1979. Remote radiation measurements were taken during and after each nuclear experiment by a telemetry system. Monitors with portable radiation detection instruments surveyed reentry routes into ground zeroes before other planned entries were made. Continuous surveillance was provided while personnel were in radiation areas and appropriate precautions were taken to protect persons from unnecessary exposure to radiation and toxic gases. Protective clothing and equipment were issued as needed. Complete radiological safety and industrial hygiene coverage was provided during drilling and muneback operations. Telemetered and portable radiation detector measurements are listed. Detection instrumentation used is described and specific optional procedures are defined.

21175 (DP-MS—79-75) **Case studies of horizontal spread of ^{85}Kr at 100 km downwind.** Weber, A.H. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1980. Contract EY-76-C-09-0001. 4p. (CONF-800327—2). Dep. NTIS, PC A02/MF A01.

From 2. joint conference on applications of air pollution meteorology; New Orleans, LA, USA (24 Mar 1980).

Some preliminary estimates of the horizontal spread of plumes at a distance of 100 km downwind have been obtained using the results of ^{85}Kr plume sampling at Savannah River Plant. Application of Taylor's theory as modified by Pasquill and Doran, Horst, and Nickola gives reasonable results. These results are a factor of 2.67 less than the ^{85}Kr measurements indicate.

21176 (EGG—1183-1759) **Aerial radiation surveys.** Jobst, J. (EG and G Idaho, Inc., Idaho Falls (USA)). 1980. Contract EY-76-C-08-1183. 11p. (CONF-800334—8). Dep. NTIS, PC A02/MF A01.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

A recent aerial radiation survey of the surroundings of the Vitro mill in Salt Lake City shows that uranium mill tailings have been removed to many locations outside their original boundary. To date, 52 remote sites have been discovered within a 100 square kilometer aerial survey perimeter surrounding the mill; 9 of these were discovered with the recent aerial survey map. Five additional sites, also discovered by aerial survey, contained uranium ore, milling equipment, or radioactive slag. Because of the success of this survey, plans are being made to extend the aerial survey program to other parts of the Salt Lake valley where diversions of Vitro tailings are also known to exist.

21177 (IDO—12082(79)) **1979 environmental monitoring program report for Idaho National Engineering Laboratory Site.** (Idaho National Engineering Lab., Idaho Falls (USA)). May 1980. Contract W-7405-ENG-82. 44p. Dep. NTIS, PC A03/MF A01.

The results of the 1979 environmental monitoring programs have shown the presence of natural radioactivity and worldwide fallout, but showed no INEL-produced radioactivity detected in the offsite environs. Concentrations and doses from radioactive materials discharged during Site operations were of no health consequence to the surrounding populations. Air, water, and foodstuff samples are routinely collected from around the INEL boundary and from locations distant from the INEL Site. This report describes the analyses and comparison of such samples to determine if there has been any contribution from INEL operations.

21178 (MLM—2700) **Annual environmental monitoring report: calendar year 1979.** Farmer, B.M.; Carfagno, D.G. (Mound Facility, Miamisburg, OH (USA)). 25 Apr 1980. Contract EY-76-C-04-0053. 49p. Dep. NTIS, PC A03/MF A01.

The local environment surrounding Mound Facility was monitored primarily for tritium and plutonium-238. The results are reported for CY-1979. The environmental parameters analyzed included air, water, vegetation, foodstuffs, and sediment. The average concentrations of plutonium-238 and tritium were within the applicable standards for radioactive species.

21179 (ORNL—5489) **Radon and radon daughter measurements at and near the former Middlesex Sampling Plant, Middlesex, New Jersey.** Haywood, F.F.; Perdue, P.T.; Christian, D.J.; Leggett, R.W.; Dickson, H.W.; Myrick, T.E. (Oak Ridge National Lab., TN (USA)). Mar 1980. Contract W-7405-ENG-26. 60p. Dep. NTIS, PC A04/MF A01.

The results of the radon and radon daughter measurements made to date (1978) at the Middlesex Sampling Plant in Middlesex, New Jersey, are presented in this report. These measurements were one portion of a more comprehensive radiological survey conducted at this site and the surrounding area from 1976 to 1978. The surveyed property served as a uranium ore sampling plant during the 1940's and early 1950's and as a result contains elevated levels of surface an subsurface contamination. On-site indoor radon daughter and radon concentrations exceeded both the US Surgeon General Guidelines and the Nuclear Regulatory Commission's maximum permissible concentration limits for radon (10 CFR Part 20) in all structures surveyed. Off-site structures showed concentrations of radon and radon daughters at or only slightly above background levels, except for one site where the radon levels were found to be above the 10 CFR Part 20 guidelines. Outdoor radon ad radon daughter concentrations, measured both on and off the site, were well below the guidelines, and the data give no indication of significant radon transport from the site.

21180 (PB—80-101314) **A study of radioactive airborne effluents from particle accelerators. Technical report (final).** Cehn, J.I. (Teknekron, Inc., McLean, VA (USA)). Aug 1979. Contract EPA-68-01-4997. 115p. NTIS, PC A06/MF A01.

This report discusses radioactive gas production around non-Federally owned particle accelerators, and the release of such gases to the atmosphere. The estimated 1200 non-Federally owned accelerators in the United States are categorized by type and energy, and the potential for radiogas production is discussed for various types. The results of field monitoring around two machines (a cyclotron and a Van de Graaff) are also presented. Estimates of annual radiogas releases from generic accelerator facilities are made. The isotopes of interest are: tritium (target gas) from a generic Van de Graaff; nitrogen-13, oxygen-15, and carbon-11 from a generic cyclotron; and argon-41 from a generic linac. Finally, control technologies to reduce airborne releases of these isotopes are discussed.

21181 (PNL-SA—7511) **Collective dose commitments due to reported radioactive releases from nuclear power plant sites in 1976.** Baker, D.A.; Decker, T. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1979. Contract EY-76-C-06-1830. 15p. (CONF-790728—7). Dep. NTIS, PC A02/MF A01.

From 24. annual meeting of the Health Physics Society; Philadelphia, PA, USA (7 Jul 1979).

In a continuation of last year's study, collective radiation dose commitments were estimated for all operating water-cooled nuclear power plant sites, utilizing atmospheric and liquid radioactivity releases reported to the Nuclear Regulatory Commission for 1976. Results are presented of collective dose commitments from these release pathways to four population groups: infant, child, teenager, and adult residing between 2 and 80 km from each site. Typical individual doses were estimated for each site and for all the sites together. The sites were rated as to their power output per unit population dose and per unit average individual dose. Results for 1976 operating reactors indicate a reduction of overall collective dose from those operating in 1975 even though more electrical energy was generated in 1976.

REGULATIONS

REFER ALSO TO CITATION(S) 20046

ENVIRONMENTAL SCIENCES, TERRESTRIAL

BASIC STUDIES

REFER ALSO TO CITATION(S) 21135

21182 (NP—24349) **Environmental impact assessment: addendum to the 1973 report. Volume A. Summary. Final report.** (Syncrude Canada Ltd., Edmonton, Alberta). Nov 1978. 73p. Dep. NTIS (US Sales Only), PC A04/MF A01.

The report is divided into two sections. The section on biophysical impacts includes subsections on the following topics: project description; geology; soils and vegetation; reclamation; water; fish and related aquatic resources; mammals; birds; air; archaeology; and, environmental information program. The second section, which covers socio-economic impacts, is divided into the following subsections: employment and population; income; housing; administration of public services; services; infrastructure; natural resources and related activities; community environment; Indian and Metis communities; and economic effects.

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 21151, 21153, 21155, 21156, 21159, 21160

21183 **Simulated forest response to chronic air pollution stress.** West, D.C.; McLaughlin, S.B.; Shugart, H.H. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *J. Environ. Qual.;* **9**: No. 1, 43-49(Jan 1980).

A mathematical model (FORET) previously developed to examine the successional dynamics of eastern deciduous forests was applied to the study of long-term interactions of air pollution stress and forest community dynamics. Differential levels of growth reduction (0, 10, and 20%) were applied to trees in three pollution sensitivity classes to simulate changes in biomass of both individual species and the entire forest stand. The response of individual species in a forest stand may differ markedly from results predicted on the basis of responses determined in the absence of plant competition. Some species may show growth enhancement in spite of pollutant stress, since they may gain a competitive advantage as a result of greater impacts on other species with which they interact in the successional process. Other species may experience much greater than anticipated beneficial or injurious impacts due to reduced competitive potential. The results presented are intended to stress important considerations to be addressed in predicting the response of a forest to stresses such as air pollution. Responses described are not intended to be final quantitative answers.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 21177, 21178, 21284

21184 (ANL—80-29) **Environmental monitoring at Argonne National Laboratory. Annual report for 1979.** Golchert, N.W.; Duffy, T.L.; Sedlet, J. (Argonne National Lab., IL (USA)). Mar 1980. Contract W-31-109-ENG-38. 99p. Dep. NTIS, PC A05/MF A01.

The results of the environmental monitoring program at Argonne National Laboratory for 1979 are presented and discussed. To evaluate the effect of Argonne operations on the environment, measurements were made for a variety of radionuclides in air, surface water, Argonne effluent water, soil, grass, bottom sediment, and foodstuffs; for a variety of chemical constituents in air, surface water, and Argonne effluent water; and of the environemetal penetrating radiation dose. Sample collections and measurements were made at the site boundary and off the Argonne site for comparison purposes. Some on-site measuremenets were made to aid in the interpretation of the boundary and off-site data. The results of the program are interpreted in terms of the sources and origin of the radioactive and chemical substances and are compared with applicable environmental quality standards. The potential radiation dose to off-site population groups is also estimated.

SOIL

REFER ALSO TO CITATION(S) 20156, 20163, 20192, 20948

21185 (ORNL—5454) **Radiological survey of the inactive uranium-mill tailings at Naturita, Colorado.** Haywood, F.F.; Jacobs, D.J.; Hubbard, H.M. Jr.; Ellis, B.S.; Shinpaugh, W.H. (Oak Ridge National Lab., TN (USA)). Mar 1980. Contract W-7405-ENG-26. 85p. Dep. NTIS, PC A05/MF A01.

Results of a radiological survey of the inactive uranium-mill site a Naturita, Colorado, conducted in May 1976, are presented. The spread of tailings was detected in the area surrounding the site by means of direct above ground gamma measurements and analysis of surface and subsurface soil samples. Radiochemical analyses of water samples in the vicinity of the tailings pile indicate local surface water contamination immediately downstream from the pile, although the ^{226}Ra concentration in the water at that point as well below the concentration guide for drinking water. The calculated subsoil distribution of ^{226}Ra in onsite holes is presented graphically. The tailings at this site were removed and reprocessed at another location. This operation was completed and reclamation of the site was conducted in 1978. Consequently the information in this report documents radiological conditions that no longer exist.

21186 (ORNL—5457) **Assessment of the radiological impact of the inactive uranium-mill tailings at Grand Junction, Colorado.** Haywood, F.F.; Goldsmith, W.A.; Jacobs, D.G.; Perdue, P.T.; Ellis, B.S.; Hubbard, H.M. Jr.; Shinpaugh, W.H. (Oak Ridge National Lab., TN (USA)). Apr 1980. Contract W-7405-ENG-26. 101p. Dep. NTIS, PC A06/MF A01.

Results of a radiological survey of the inactive uranium-mill site at Grand Junction, Colorado, made in May and June 1976, are presented along with descriptions of techniques and equipment used to obtain the data and an assessment of increased risk of health effects attributable to radiation and radionuclides from the tailings. The data obtained indicate that the tailings are adequately stabilized to prevent significant wind and water erosion. The average above-ground gamma-ray exposure rate measured over the tailings pile was 170 μR/hr and that around one of the former mill buildings was 100 μR/hr. Soil samples at a distance of 960 m to the east and west of the center of the tailings pile contained an above-background level of ^{226}Ra. An estimate of potential health effects of exposure to gamma rays around a former mill building and to radon daughters produced by radon dispersed from the tailings has been made for occupants of the site.

TERRESTRIAL ECOSYSTEMS AND FOOD CHAINS

21187 (PNL—2636) **Simulation of the long-term accumulation of radiocontaminants in crop plants.** Schreckhise, R.G. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Mar 1980. Contract EY-76-C-06-1830. 68p. Dep. NTIS, PC A04/MF A01.

Most radiological dose assessment models ignore the long-term buildup of radiocontaminants in the soil. When they estimate levels in crop plants from root uptake, these models account only for the annual input from the source into the soil. Almost all of the models ignore the build-up of contaminants in the soil profile due to the accumulation in the roots and the build-up from the above-ground plant material that is buried by plowing. The model described in this report simulates the entire system involved in the cycling and accumulation of radionuclides in cultivated land. The model, named CROPRE, was developed to predict both the long-term accumulation of radionuclides and the resulting concentrations of radionuclides in vegetation. This model was designed to include: (1) the chronic input of contaminated irrigation water into both the soil compartment and directly onto the surface of the vegetation; (2) the incorporation of radiocontaminants in the soil organic matter pool and their eventual release for re-uptake by subsequent crops; (3) the removal of contaminants from the system when the crops are harvested; and (4) the downward movement of radionuclides and their loss from the system by percolation. The CROPRE model more realistically simulates the cycling of radiocontaminants in crop plants over long periods of time than does the other models. It is recommended that it be incorporated into existing radiation dose commitment models.

21188 (RFP—3052) **Plutonium/americium inventory of a pond ecosystem near the Rocky Flats Facility.** Hurley, J.D.; Winsor, T.F. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1980. Contract EY-76-C-04-3533. 6p. (CONF-800607—10). Dep. NTIS, PC A02/MF A01.

From American Nuclear Society annual meeting; Las Vegas, NV, USA (8 Jun 1980).

The data indicate that concentrations of ^{239}Pu exceed fallout background levels in soil and sediment. However, the levels in soil and vegetation indicate substantial dilution at this location downwind from a previously studied area near the source. Radioecological data for ^{241}Am reported herein are the first at Rocky Flats. The measurement accuracy however, for ^{241}Am and ^{238}Pu is not yet well established at such low levels. Calculated inventories reveal that the greatest quantities of the three radioisotopes reside in soil and sediment. This information verifies the pattern of previously ob-

tained data on radionuclide distributions at Rocky Flats in terrestrial and aquatic environments, but at concentration levels lower by one or more orders of magnitude. In the latter sense, the present data are unique and useful.

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 19993, 19994, 20000, 20001, 20044, 20178, 21207, 21225

21189 (RLO—2232-T2-11) **Survey of viability of indigenous grasses, forbs, and shrubs: techniques of initial acquisition and treatment for propagation in preparation for future land reclamation in the Fort Union Basin. Annual progress report, June 1, 1979-May 31, 1980.** Eddleman, L.E. (Montana Univ., Missoula (USA)). Feb 1980. Contract EY-76-S-06-2232-002. 91p. Dep. NTIS, PC A05/MF A01.

A broad range of interactions relative to the basic biology of plant species indigenous to Southeastern Montana is covered. The following subjects are discussed: seed dormancy; drought and salt stress effects on germination and seedling emergence; preconditioning of seed; seedling emergence and establishment under field planting; competition study; and rooting study of selected species. Many species investigated under this project have been found to possess a high potential for reestablishment on topsoiled coal mine spoils. (DC)

21190 **Reclamation of disturbed arid lands.** Wright, R.A. (ed.). Albuquerque, NM; University of New Mexico Press (1978). 206p. (CONF-770271—). $4.95.

From Symposium on reclamation of disturbed arid lands; Denver, CO, USA (20 Feb 1977).

Current and recent research on the reclamation of lands disturbed by mining activity in arid regions of the USA was presented at this symposium. Separate abstracts are prepared for individual items.

21191 **Economics of mined land reclamation and land-use planning in western states.** LaFevers, J.R. (Argonne National Lab., IL). pp 68-71 of Reclamation of disturbed arid lands. Wright, R.A. (ed.). Albuquerque, NM; University of New Mexico Press (1978).

From Symposium on reclamation of disturbed arid lands; Denver, CO, USA (20 Feb 1977).

The economics of land reclamation at sites where the benefits of returning the land to premining conditions are questionable are discussed. Mine sites in arid and semiarid states of the western US were examined. Land use planning, prior to mining, involving the local or regional land use planners, is suggested in order to develop marketing strategies for reclaimed sites. Planning so that the value of the land exceeds the cost of reclamation and is beneficial to the mining company and the public is discussed. Land reclamation costs can run as high as 30 times land value. (DC)

REGULATIONS

REFER ALSO TO CITATION(S) 20044, 21228, 21229, 21230, 21231

ENVIRONMENTAL SCIENCES, AQUATIC

BASIC STUDIES

REFER ALSO TO CITATION(S) 19993, 20051, 21135, 21182, 21248, 21349

21192 (AD-A—072587) **Numerical case studies for oceanic thermal anomalies with a dynamic model.** Huang, J.C.K. (National Oceanic and Atmospheric Administration, Ann Arbor, MI (USA). Great Lakes Environmental Research Lab.). 1979. 41p. NTIS PC A03/MF A01.

Numerical investigations to identify the physical processes responsible for the generation, evolution, and dissipation of oceanic thermal anomalies (OTA) were carried out using the numerical dynamic model of the North Pacific Experiment (NORPAX). The NORPAX model is based on time-integrations of the finite-difference forms of the primitive equations. It possesses an actual coastal configuration and 10 vertical layers, with a constant maximum depth of 4 km. The horizontal grid spacing, both longitudinal and latitudinal, is 2.5 deg. The seasonally varying model climatology is generated by integrating the model over 80 years of simulations under the climatological atmospheric forcing with the last 20 years varying with the seasonal cycle. Large-scale features of the model ocean climatology compare favorably with observed large-scale motions and structure in the North Pacific Ocean. The model is used for oceanic thermal anomaly studies. Two simulated cases are presented: one demonstrates the generation and evolution of OTA's under anomalous atmospheric wind forcing of winter 1949-50, and the other portrays the evolution and dissipation of the OTA's under climatological atmospheric conditions in winter 1971-72.

21193 (BNL—51111) **Design, construction, and initial operation of the BNL-coastal transport and diffusion, Air/Sea Interaction research buoy. Data report.** Huszagh, D.; Ripperger, W.; Fink, S. (Brookhaven National Lab., Upton, NY (USA)). Oct 1979. Contract EY-76-C-02-0016. 23p. Dep. NTIS, PC A02/MF A01.

Design features of the Brookhaven National Laboratory (BNL) Air/Sea Interaction (A/S-I) buoy are described, and construction, testing, and deployment experiences are related. This two-attitude buoy is similar to the MIT/Navy buoy which it replaces, but it accommodates more instruments and can be towed through shallower water. The BNL A/S-I buoy can be broken down into two, three, or four sections to facilitate overland transport. Compressed air is stored aboard and the controls for deploying, trimming, and recovering the buoy are centralized on the superstructure and are perpetually above water level. The ballast control plumbing is entirely within the hull for maximum protection. The buoy also has a propane storage and distribution system and a 40-watt thermoelectric generator for powering instruments. Two buoys were built and tested in 1978, and one buoy was deployed in 1979 and is in operation off the south coast of Long Island.

21194 (BNL—51139) **Spar Buoy Oceanographic Telemetry System operational modifications.** Divis, E.; Hopkins, T.; Pfeiffer, V.; Carlson, D. (Brookhaven National Lab., Upton, NY (USA)). Dec 1979. Contract EY-76-C-02-0016. 13p. Dep. NTIS, PC A02/MF A01.

Brookhaven National Laboratory has been deploying Spar Buoy Oceanographic Telemetry Systems in coastal waters off Shinnecock, New York since 1976. To be able to judge effectively the relative values of new offerings we must have in mind basic standards, for a known figure is of no value unless it is compared to a known value. In this report, the mechanical and electronic performance of the Spar Buoy System, SBOTS (Spar Buoy Oceanographic Telemetry System), is evaluated with special reference to modifications and repairs that have enhanced the probability of continued success, both in operational deployment and data recovery. To invest the SBOTS system with a reliability which would anticipate all possible hazards would be desirable, although impossible; as an adjunct to this goal we present a brief description of the repairs, modifications, and changes which have been initiated to increase reliability during deployment.

21195 (CONF-7804163—(Vol.2), pp 1127-1147) **Use of SAR systems for iceberg detection and characterization.** Larson, R.W. (Environmental Research Inst. of Michigan, Ann Arbor); Shuchman, R.A.; Rawson, R.F.; Worsfold, R.D. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

During February and March 1977, a synthetic aperture radar (SAR) program was conducted on the east coast of Canada using a 3 cm and 23 cm dual polarization SAR system. Data obtained from this program have been used to demonstrate the capability of SAR for the detection and identification of icebergs. Results from the analysis and interpretation of the 3 cm and 23 cm SAR imagery are presented. These results include imagery and quantitative measurements, demonstrating the detectability of icebergs in a variety of sea ice clutter backgrounds. Using imagery having resolution of 3 meters by 3 meters, it is possible to estimate iceberg by using the detail of the iceberg shadow. The information obtained from this program can be used for the design of future operational SAR systems for iceberg detection and characterization.

21196 (FWS/OBS—80/16) **Effects of low levels of oil on aquatic birds: a non-technical summary of research activities FY76 through FY78.** Biderman, J.O.; Drury, W.H. (College of the Atlantic, Bar Harbor, ME (USA)). Mar 1980. 7p. Information Transfer Specialist, Slidell, LA.

The reproductive period, including the time of growth and development of the young, is a highly sensitive time for any animal when physiological systems are acting at critical rates. Any slight interference, such as the addition of a stressful or toxic agent is likely to be disastrous. It has been demonstrated that exposure of adult waterbirds or their developing young to slight amounts of petroleum can seriously interfere with the reproductive process. Effects can range from interference with the physiology of reproduction to killing of embryos, production of developmental defects, stunting of growth and impairment of survival ability when birds are stressed. Oil can be taken up by adults in their food or picked up on their feathers, and from them can be transferred to eggs or nestlings. Managers should be conscious of these effects, which though less

apparent in nature, may in fact be more serious than the infrequent kill-offs occurring after catastrophic spills. For it may well turn out that a chronic reduction in reproductive success may be the most significant effect of oil pollution on populations of aquatic birds.

21197 Distribution of suspended bacteria in neritic waters south of Long Island during stratified conditions. Ferguson, R.L. (National Marine Fisheries Service, Beaufort, NC); Palumbo, A.V. Contract AT/(49-7)-5. *Limnol. Oceanogr.;* **24**: No. 4, 697-705(Jul 1979).

Bacteria (direct counts) averaged 1.85 x 10^6 cells.ml^{-1} in highly stratified waters south of Long Island during September 1976. The vertical distribution of bacteria was related to the location of the thermocline and the bottom, the horizontal distribution to distance from shore indicating longshore continuity. The average numbers of bacteria (x 10^6 cells.ml^{-1}) in neritic water were 2.14 nearsore, 1.96 midshelf, and 0.67 near the shelf break. Overall the number of bacteria was positively correlated with chlorophyll and ammonium concentrations but not with measurements of heterotrophic activity. The location of a large, relatively inactive population of bacteria cells near the surface of the highly stratified midshelf water corresponds to the approximate location of unusually persistent phytoplankton blooms observed during March-June 1976.

21198 Biochemical correlates of seasonal change in marine communities. Jeffries, H.P. (Univ. of Rhode Island, Kingston). Contract EP-78-5-02-4941-A. *Am. Nat.;* **113**: No. 5, 643-658(May 1979).

Plankton and benthos respond in different ways to seasonal change, but their patterns of fatty acid distribution are similar. The general trend of chemical progression is toward longer chain lengths and increasing unsaturation. Thus, as a temperate community matures and becomes more complex, so does its fatty acid composition. Chemical progression is most rapid during succession from winter-spring to summer-fall species groups, a period of reorganization among characteristic fatty acid sets. Increasing amounts of saturated acids seem to disclose a change in community structure, whereas an important polyunsaturate forms a locus around which these progressions take place. Structural change within a community can be portrayed in a space defined by its fatty acid variables. The patterns formed here were oval over an annual cycle. An embellishment on the benthic pattern corresponded to collapse in a pioneer stage and subsequent reorganizaton at a higher taxonomic level. In general however, benthos had a less robust trajectory in fatty acid space than plankton. Biochemical sample patterns are believed to bear sufficient correspondence to the stable domain of parameter space for convenient testing of stability theories. Because they are based on ubiquitous monomers, these patterns also permit fundamental comparisons between natural communities in various states and conditions.

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 19990, 19992, 19995, 20063, 20064, 20065, 20093, 20833, 20834, 20954, 21151, 21153, 21155, 21156, 21159, 21160, 21184, 21335, 21358

21199 (ANL—78-65(Pt.3)) **Radiological and Environmental Research Division: ecology. Annual report, January-December 1978.** (Argonne National Lab., IL (USA)). 1978. Contract W-31-109-ENG-38. 129p. Dep. NTIS, PC A07/MF A01.

Ecological studies continue to focus on the determination of the effects of energy-related pollutants on planktonic species typical of the Great Lakes. Also included were experimental studies of the effects of enclosure size on the response of zooplankton to stress by cadmium. A new mobile field laboratory was constructed to support studies of the effects of water temperatures regimes on rates of accumulation by salmonid fishes of persistent organic contaminants such as PCB's. A significant new addition to the Great Lakes Research Program was marked by the arrival and formal acceptance of the new research vessel, the R/V Ekos. Descriptions of the Ekos and its research capabilities are included. A variety of studies of the behavior of transuranic elements conducted in environments as diverse as the Irish Sea, Great Slave Lake, the Great Miami River, and the Great Lakes, have focused on changes in the oxidation state of plutonium, and the effects these changes have on the behavior of this important element in the aquatic environment. Twenty-six sections of the report were abstracted and indexed individually for inclusion on ERA/EDB and those in scope for INIS. (JGB)

21200 (ANL—78-65(Pt.3), pp 52-54) **Preliminary observations of the effects of rainwater addition on Lake Michigan phytoplankton primary productivity.** Parker, J.I. 1978.

In Radiological and Environmental Research Division: ecology. Annual report, January-December 1978.

The rate of phytoplankton primary production may be increased by phosphate additions from rain or reduced by toxic trace elements in the rain. Hypothetically then, the co-occurrence of a phytoplankton bloom (when production rates are maximal) and a dirty rainfall event could increase or decrease the quantity of organic matter produced. This could substantially alter annual productivity rates since greater than half of the annual productivity occurs during bloom periods in the spring and fall. To test this hypothesis a series of experiments are being conducted to measure the change in primary production rate (^{14}C uptake) in water samples containing the natural assemblage of Lake Michigan phytoplankton treated with various additions of filtered rainwater. Samples treated with 5.0% rainwater showed production rates that averaged approximately 10% higher than those of the control samples, while an increase to 10% rainwater resulted in productivity levels equal to those of the control samples. However, further incremental additions of rainwater progressively reduced primary production, and the rate in the 50% rainwater treatment averaged <50% of the rate in the control samples. These preliminary findings suggest additions of rainwater less than 10% stimulate primary production. Phosphates in the rainwater may be the stimulating agent. Toxic constituents, such as trace elements or changes in pH caused by acidic pollutants in the rainwater, may be responsible for the observed reductions in productivity rate at higher dilution ratios. It appears that the stimulating effect of low-level rainwater additions are masked by the toxic effects of rainwater additions in excess of 10%.

21201 (ANL—78-65(Pt.3), pp 106-112) **Preliminary mass balance calculations for cadmium in southern Lake Michigan.** Muhlbeier, J.; Tisue, T. 1978.

In Radiological and Environmental Research Division: ecology. Annual report, January-December 1978.

Although present concentrations of cadmium in the waters and sediments are very small, it is important to know whether the concentrations are likely to increase, and if so, at what rate. The approach taken was to compare the sum of input rates from the major sources to the sum of removal rates to the major sinks. Sources considered were rain and snow, dry deposition from the atmosphere, shore erosion, tributaries, and runoff from the land; as sinks, natural outflow sedimentation. Results indicate that Cd is being added to Lake Michigan two or three times faster than it being removed.

21202 (BNL—51068) **New techniques for analyzing relationships between energy and water quality.** Kaplan, E.; Thode, H.C. Jr. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract EY-76-C-02-0016. 70p. Dep. NTIS, PC A04/MF A01.

Water quality data for 65 variables were obtained for the period 1955 to 1977 and aggregated on a county basis. Measurements were taken primarily in New England and the Middle Atlantic States. When a subset of 138 counties with complete data was used, it was found that county aggregation statistical procedures resulted in data still able to describe the chemical characteristics of natural waters. Energy and socioeconomic data were merged with water quality data for these 138 counties. The path analytic methodology used by geneticists was adapted for use with these combined data to investigate for potential interactions between energy-related activities and water quality. A path diagram was proposed to provide insight into the possible causal nature of these interrelations. Direct and indirect pathways from energy production and use were traced to three factors describing functional attributes of water: conductivity, hardness, and dissolved metallic ions. This analysis explained 25 to 40% of the variance in three water quality factors and indicated the applicability of this technique to regional assessments of water quality impacts due to many human activities.

21203 (CONF-800349—2) **Relationships between stripmining-induced changes and benthic insect communities in the southern Appalachian Region.** Tolbert, V.R. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 3p. Dep. NTIS, PC A03/MF A01.

From Annual meeting of the North American Benthological Society; Savannah, GA, USA (Mar 1980).

Increased demands for coal to supply America's energy needs, as well as the controversy surrounding the requirements and enforcement of the Surface Mining Control and Reclamation Act of 1977, point directly to the need for determination of specific factors associated with stripmining alteration that produce major environmental impacts. Numerous studies have demonstrated physical and chemical alterations to southern Appalachian streams subject to stripmining effluents found that the two major factors resulting in physical alterations were increased runoff and resultant sedimentation. Studies in streams receiving acid mine drainage showed that benthic insect communities differed in undisturbed and stripmining disturbed streams. Branson and Batch noted differences in benthic communities in Kentucky streams disturbed by non-acid stripmining. Tolbert found significant differences in benthic communities between undisturbed and nonacid mining streams. This paper describes research to determine what stripmining-altered parameters are responsible for differences in benthic insect communities. The results of this study can be applied toward validation of control measures required by the Surface Mining Control and Reclamation Act.

21204 (CONF-7910138—2) **Kinetic model for predicting the concentrations of active halogen species in chlorinated saline cooling waters.** Lietzke, M.H.; Haag, W.R. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA). Dept. of Chemistry). 1979. Contract W-7405-ENG-26. 13p. Dep. NTIS, PC A02/MF A01.

From 3. conference of chlorination: environmental impact and health effects; Colorado Springs, CO, USA (28 Oct 1979).

A kinetic model for predicting the composition of chlorinated water discharged from power plants using fresh water for cooling was previously reported. The model has now been extended to be applicable to power plants located on estuaries or on the seacoast where saline water is used for cooling purposes. When chloride is added to seawater to prevent biofouling in cooling systems, bromine is liberated. Since this reaction proceeds at a finite rate there is a competition between the bromine (i.e., hypobromous acid) and the added chlorine (i.e., hypochlorous acid) for halogenation of any amine species present in the water. Hence not only chloramines but also bromamines and bromochloramines will be formed, with the relative concentrations a function of the pH, temperature, and salinity of the water. The kinetic model takes into account the chemical reactions leading to the formation and disappearance of the more important halamines and hypohalous acids likely to be encountered in chlorinated saline water.

21205 (DOE/EV/10216—1) **Bomb radiocarbon sections along the Hawaii-Tahiti shuttle track. Annual progress report.** Stuiver, M. (Washington Univ., Seattle (USA)). 27 Feb 1980. Contract AT06-79EV10216. 7p. Dep. NTIS, PC A02/MF A01.

The objective of the research is to use the temporal and spatial distribution of the transient, bomb-produced ^{14}C in the equatorial Pacific Ocean to determine mixing rates in the upper 1000 m of the ocean. To accomplish this goal approximately 400 ^{14}C samples were collected during two legs of the NORPAX shuttle. There is extensive relative depletion in ^{14}C of the equatorial surface waters. This feature of the surface water ^{14}C distribution, coupled with the depth distribution of ^{14}C and the physical and chemical (nutrient) oceanographic data collected during the NORPAX program should allow us to estimate the rate of upwelling in the equatorial Pacific.

21206 (DOE/TIC—11161) **Comprehensive plan for carbon dioxide effects research and assessment. Part I: the global carbon cycle and climatic effects of increasing carbon dioxide.** (Department of Energy, Washington, DC (USA). Office of Carbon Dioxide Research and Assessment). May 1978. 68p. Dep. NTIS, PC A04/MF A01.

The well-documented increase of carbon dioxide in the atmosphere has lead to concern about the impact on the world's climate. To obtain answers to the many questions raised by this issue requires a research program of considerable magnitude and scope conducted over at least a decade. Presented here is an outline of some of the specific research needed to attack the problems. These problems are: (1) What will be the future atmospheric concentrations of CO_2, (2) What will be the climatic effect of these concentrations, (3) What will be the effect on the biological and physical environment of these climate changes coupled with the increases of CO_2, (4) What, if any, will be the effects of these changes on human societies, and (5) In the event that these changes are undesirable, what actions can be taken to prevent them. The research outlined in this document addresses mainly the first two questions because there are the first steps in defining the problems.

21207 (PB—80-100597) **Environmental characterization, management and planning, six-month progress report (3rd). Progress report, 1 May 1971-30 April 1974.** Bryson, R.A. (Wisconsin Univ., Madison (USA). Inst. for Environmental Studies). Jan 1973. 103p. NTIS, PC A06/MF A01.

The Institure for Environmental Studies projects describes solutions which focus on real problems of the man-environment system. These investigations are being conducted by five centers and two groups: (1) The Center for Biotic Systems defines population problems and explores how they can be solved; (2) The Center for Climatic Research studies the sensitivity of cultures to environmental change; (3) The Center for Geographic Analysis investigates interdisciplinary environmental problems related to geographic aspects, especially land and inland water systems; (4) The Center for Human Systems is concerned with systematic analysis and modeling of human and institutional factors in environmental matters; (5) The Marine Studies Center promotes, coordinates, and conducts research on the marine environment; (6) The Environmental Monitoring and Data Acquisition Group develops research expertise and training opportunities in the realm of environmental acquisition and handling; and (7) The Quantitative Ecosystem Modeling Group develops modeling capability for environmental systems. Specific projects are described in detail.

21208 (PB—294794) **Identification of organic compounds in industrial effluent discharges.** Perry, D.L.; Chuang, C.C.; Jungclaus, G.A.; Warner, J.S. (Battelle Columbus Labs., OH (USA)). Feb 1979. 244p. (EPA—600/4-79-016). NTIS, PC A11/MF A01.

Portions of this document are illegible.

Samples of 63 effluent and 22 intake waters were collected from a wide range of chemical manufacturers in areas across the United States. The samples were analyzed for organic compounds in an effort to identify previously unknown and potentially hazardous organic pollutants. All sample analyses involved a GC/MS/COMP system that used high-resolution glass capillary GC columns. Organic constituents were identified using the computerized Biemann mass spectral matching system together with some manual interpretation and quantified using GC-FID peak area determinations. Over 570 compounds were tentatively identified of which 33 are priority pollutants. Generally, industrial effluents contained few priority pollutants. Most of the components found in the effluents were specific for a particular industrial site and did not appear in reoccurring patterns. The data suggest that many possible environmentally important compounds would be overlooked if frequency of occurrence is the major criterion for determining environmentally significant compounds.

21209 (PNL-SA—7883) **Organohalogen production from chlorination of natural waters under simulated biofouling control conditions.** Bean, R.M.; Mann, D.C.; Wilson, B.W.; Riley, R.G.; Lusty, E.W.; Thatcher, T.O. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Sep 1979. Contract EY-76-C-06-1830. 13p. (CONF-7910138—1). Dep. NTIS, PC A02/MF A01.

From 3. conference of chlorination: environmental impact and health effects; Colorado Springs, CO, USA (28 Oct 1979).

In order to develop information concerning the range of organohalogen products to be expected from low-level chlorination practices, such as those used for biofouling control in electricity generating plants, the organic chlorination chemistry of natural waters have been investigated at 10 locations in the continental United States. The specific objective of our investigations was to document the formation of organohalogen material which by virtue of acutely toxic properties or bioaccumulation potential, could have deleterious effects on aquatic environments. This paper is intended to serve as an overview of results to date. This work is part of an interdisciplinary program to study the environmental chemistry and aquatic toxicology associated with current cooling water treatment practices.

21210 (RLO—2225-T40-17) **Hydrocarbon studies in Puget Sound and off the Washington coast. Progress report, March 1979-February 1980.** Carpenter, R. (comp.). (Washington Univ., Seattle (USA). Dept. of Oceanography). Feb 1980. Contract EY-76-S-06-2225-040. 9p. Dep. NTIS, PC A02/MF A01.

Progress is summarized on studies of the amounts, types and probable origins of aliphatic, aromatic, S- and N-containing hydrocarbons in sediments, organisms, and waters of Puget Sound and the Washington coast. An attempt is being made to identify the relative importance of the various possible sources of these substances, the major pathways by which they are transferred through some parts of the marine food web, their rates of transfer, and their ultimate fates. Changes in aliphatic, aromatic, and N-containing hydrocarbon compositions are evident in ^{210}Pb-dated sediment cores from central Puget Sound. These changes are due both to natural diagenetic processes and to low level inputs of fossil fuels from a variety of sources. Measurable amounts of S-containing hydrocarbons were found in these sediments which are largely due to natural sources. Studies of the role of zooplankton fecal pellets in the cycling of trace chemicals in the sea indicated that fecal pellets are an important vertical transport agent for hydrocarbons.

21211 **Assessment of water quality impacts of a western coal mine.** Dettmann, E.H.; Olsen, R.D. (Argonne National Lab., IL). pp 53-67 of Reclamation of disturbed arid lands. Wright, R.A. (ed.). Albuquerque, NM; University of New Mexico Press (1978).

From Symposium on reclamation of disturbed arid lands; Denver, CO, USA (20 Feb 1977).

Anticipated expansion of coal mining in many western states implies a potential impact on water resources. The magnitude of the impact will be determined by the mining technology employed, and the associated hydrologic, meteorologic, and geologic characteristics of the mine locality. Information describing historical and/or current aquatic impacts of western coal mining is limited. Because of fundamental regional differences in coal chemistry, as well as climatic and hydrologic differences, the environmental impacts to western aquatic systems will differ significantly from those found in eastern coal mining regions. At western mines, acid drainage and the associated toxic metals, common in the east, should be minimal because of the small amounts of acid-forming substances and the generally alkaline nature of overburden and soils. Available research on western mines indicates that leaching of soluble salts from mine spoils and transport of these salts to receiving surface or groundwater systems, as well as erosion-induced sedimentation, are among the principal water quality problems that can be expected. Also of concern in arid and semiarid regions are the potential adverse impacts of mining on alluvial valley floors. The unconsolidated deposits often exist in a state of delicate hydrologic balance, which if upset could preclude

future use of the area for agriculture and could also result in degradation of stream or groundwater quality. This report describes interim results of a water quality investigation carried out during 1975-76 in the vicinity of the Big Horn Mine, an operating surface coal mine in the northwestern part of the Powder River Basin, Wyoming. While an extensive array of water quality parameters was monitored, the results reported here pertain primarily to those highly soluble constituents and related parameters that do not readily enter into chemical or biological reactions.

21212 **Safe drinking water: current and future problems.** Russell, C.S. (ed.). Washington, DC; Resources for the Future (1978). 660p. (CONF-7803120—). $12.00.

From National conference on drinking water policy problems; Washington, DC, USA (6 Mar 1978).

The thirteen papers presented at the conference are entitled: drinking water policy problems; background of the current situation on drinking water and health; water and epidemiology; toxicology relevant to drinking water policy; European experience with problems of drinking water quality; British experiences on problems of drinking water quality; water and the food industries; meeting the drinking water standards; the price of regulation; financing system changes; consumer perception and choice of drinking water quality; options for coping with the Safe Drinking Water Act; and local governments and the Safe Drinking Water Act. A panel discussion was held on policy alternatives. (JGB)

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 21177, 21178, 21181, 21284

WATER

REFER ALSO TO CITATION(S) 20153, 20155, 20163, 20172

21213 (ANL—78-65(Pt.3), pp 64-68) **Plutonium in fresh water.** Wahlgren, M.A.; Nelson, D.M.; Orlandini, K.A.; Larsen, R.P. 1978.

In Radiological and Environmental Research Division: ecology. Annual report, January-December 1978.

The concentrations of plutonium and thorium in a group of freshwater lakes having a wide variety of limnological characteristics have been reported previously. The concentrations of uranium, the Pu(VI)-to-Pu(IV) concentration ratios in these waters, and the concentrations of plutonium, thorium, and uranium in suspended sediment, were determined and are tabulated. The small differences between some of the values in this table and those reported previously are the result of a change in the method used to calculate concentrations from the data obtained in alpha spectrometric assays. At present strong correlations between the plutonium, thorium, or uranium concentrations and the limnological parameters, pH and alkalinity, appear to exist. A series of laboratory experiments are in progress to determine whether the systematic trends suggested by the field data can be duplicated using Pu tracers in known oxidation states and various amorphous oxide substrates.

21214 (ANL—78-65(Pt.3), pp 70-73) **^{239,240}Pu in Lake Michigan: 1971 to 1978.** Wahlgren, M.A.; Nelson, D.M.; Orlandini, K.A.; Kucera, E.T. 1978.

In Radiological and Environmental Research Division: ecology. Annual report, January-December 1978.

The plutonium concentration data presented previously have consisted primarily of results from studies of short-term variations, i.e., the annual plutonium cycle conducted at Lake Michigan station ANL-5, 12 km SW of Grand Haven, Michigan. In this report, mean annual concentrations of total plutonium in unfiltered water from far off-shore (> 30 km) stations for the period 1971 through 1977, and from station ANL-5 (1975 through 1978) are summarized to establish the long-term trend in plutonium concentration in Lake Michigan. The results presented show that the mean annual concentration in the water column is similar at ANL-5 and at offshore stations and has decreased at the rate of only 6% per year during the period 1972 through 1978. The nearly constant concentration indicates that steady-state equilibria exist between plutonium inputs to the lake and the loss of plutonium from the water column. Observations suggest the existence of an active redox cycle for Pu in Lake Michigan. In this cycle, Pu IV atoms in solution are continually taken up by particulate materials but may be oxidized within microzones of the particles such as freshly deposited manganese coatings and also in solution by agents such as dissolved oxygen. In turn, the concentration of Pu VI in solution may be limited by reaction with reducing constituents of the coloidal-sized fraction (or decomposer organisms such as bacteria or fungi, which might have been present after filtration) and with planktonic organisms in the environment to produce Pu IV and thus maintain the cycle. (JGB)

21215 (ANL—78-65(Pt.3), pp 74-76) **Determination of plutonium oxidation state in large volumes of natural water.** Wahlgren, M.A.; Orlandini, K.A.; Nelson, D.M. 1978.

In Radiological and Environmental Research Division: ecology. Annual report, January-December 1978.

A method was developed to determine the relative concentrations of the lower and upper oxidation states of plutonium in large volumes of natural water. It is based on the classical lanthanum fluoride procedure in which Pu(III) and Pu(IV) are separated from Pu(VI) and most of the othe sample constituents by sequential precipitations of lanthanum fluoride. The first precipitation is carried out in the presence of Cr(VI), which oxidizes Pu(III) to Pu(IV) and Pu(V) to Pu(VI). Pu(IV) is carried on the first precipitate; Pu(VI) is reduced to Pu(III) by Fe(II) and is hence carried on the second precipitate. The plutonium fractions are separated from lanthanum by dissolving the precipitates in an aluminum nitrate-nitric acid solution, passing this solution through a Dowex-1 anion exchange column, washing the column with strong nitric acid, and eluting the plutonium from the column with a dilute hydrochloric acid-hydrofluoric acid solution. The fractions are electrodeposited onto planchets, and the depositions are assayed alpha spectrometrically. The isotopic diluents, ^{242}Pu in the IV state and ^{236}Pu in the VI state, as well as nitric and dichromate are added at the time the samples are taken. All the other operations can be performed in the laboratory at a later date. The period from the time a sample is taken to the time the laboratory work is performed may be as long as 30 days. The values obtained for the Pu(VI)-to-Pu(IV) concentration ratio when Lake Michigan water was analyzed by the lanthanum fluoride method agreed with those obtained by an independent method.

21216 (ANL—78-65(Pt.3), pp 77-79) **Sediment trap methodology.** Wahlgren, M.A.; Nelson, D.M.; Chase, E.M. 1978.

In Radiological and Environmental Research Division: ecology. Annual report, January-December 1978.

The processes by which dissolved pollutants from atmospheric or tributary inputs are deposited in local regions of the bottom sediments of Lake Michigan are known only in part. Settling particulate material must play a major role in these processes, but sediment traps have been used only rarely in the Great Lakes. The trap and mooring designs developed during the plutonium study in Lake Michigan are presented, and the experience with their use is summarized. the traps used were right circular cylinders, and the mooring arrangement an adaptation of the U system often used in current-meter studies.

21217 (ORNL—5573) **Evaluation of models used for the assessment of radionuclide releases to the environment: summary of documentation, April 1976-June 1979.** Kanak, K.A.; Miller, C.W. (comps.). (Oak Ridge National Lab., TN (USA)). Apr 1980. Contract W-7405-ENG-26. 70p. Dep. NTIS, PC A04/MF A01.

A project is underway at Oak Ridge National Laboratory (ORNL) to identify models available for environmental radiological assessments; to evaluate model structure simplifying assumptions and data bases; to estimate their uncertainties; and, if possible, to recommend the models and parameters that are best suited to particular assessment situations. When needs are identified, recommendations are also made for further environmental and biomedical research. The purpose of this particular report is to summarize the progress made toward the goals of this project to date. Such progress is reflected in the documents produced by the staff of the project. Therefore, this report presents a compilation of the abstracts and summaries of the Laboratory reports, open literature publications, conference proceedings, and oral presentations prepared under the auspices of this project. A total of thirty-eight different papers are represented in this collection. The models considered in these materials are those developed for the prediction of atmospheric transport and deposition, surface water transport and sorption, terrestrial and aquatic food-chain bioaccumulation, and internal dosimetry. Topics covered in the report include: (1) methods for analyzing models; (2) analysis of model input parameters; (3) model validation studies; (4) assessments of particular nuclides and processes; (5) recommendations concerning models and parameters to be used for assessment purposes; and (6) models and computer codes developed during the course of the project. This report will serve as a guide to the literature for those involved with the use and application of environmental radiation assessment models.

21218 (RLO—2227/T30-3) **Cycling of transuranic radionuclides in the Columbia River, its estuary and the northeast Pacific Ocean. Progress report, February 1979-February 1980.** Beasley, T.M. (Oregon State Univ., Corvallis (USA). School of Oceanography). 1980. Contract EY-76-S-06-2227-030. 58p. Dep. NTIS, PC A04/MF A01.

This report summarizes progress from February 1979 through January 1980 on the measurement of radionuclides in the Columbia River and its estuary, with principal emphasis on transuranic radionuclides. Accomplishments and pertinent findings of the 3 year interval are summarized and future directions for the research are presented. The first part of the report will draw on information cor

tained in the previous two submissions as well as results from this contract year. This will hopefully present a synoptic view for outside reviewers and the Department of Energy.

21219 Radium and thorium isotopes in the surface waters of the East Pacific and coastal Southern California. Knauss, K.G. (Univ. of California, Livermore); Ku, T.L.; Moore, W.S. Contract W-7405-ENG-48. *Earth Planet. Sci. Lett.;* **39**: 235-249(1978).

A fiber extraction technique is used to concentrate Ra and Th isotopes from 1000 liters or more of seawater. Natural ^{226}Ra and ^{234}Th are used as yield tracers. In the equatorial Pacific the ^{226}Ra activity of surface water varies from 20 to 1 dpm/1000 kg and generally decreases away from continental shelf areas. Across the Peru Current System, this decrease is modeled as one-dimensional diffusion and indicates the possibility of two flow regimes with distinct characteristic mixing lengths and apparent eddy diffusivities of 10^8 and 10^7 cm^2/s. The perturbing effects of advection and equatorial upwelling west of the Galapagos Islands are noted. Off the coast of Southern California a vertical ^{226}Ra distribution gives an apparent diffusivity of 1.6 cm^2/s for the upper thermocline. ^{226}Ra concentrations near the coast appear to be higher than the open ocean values at comparable depths, which may reflect supply of this isotope from continental shelf sediments and/or upwelling. The insoluble daughter/soluble parent activity ratios ^{230}Th/^{226}Ra and ^{234}Th/^{238}U in the equatorial Pacific surface water display latitudinal trends which may be correlated with productivity variations. Near the coast of California these ratios reflect the differing oceanographic conditions north and south of Pt. Conception indicating a mean chemical removal time constant on the order of 4 months for Th and other highly reactive elements within the Southern California Bight. The ^{232}Th content of seawater sampled is less than 0.1 μg/1000 l; most of the published values for seawater ^{232}Th could well be too high. A comparison of the two methods of determining ^{228}Ra (via ^{228}Ac and via ^{230}Th) made on 64 seawater samples shows that the time delay required by the ^{230}Th method is more than compensated by its better analytical simplicity and precision. 9 figures, 7 tables.

AQUATIC ECOSYSTEMS AND FOOD CHAINS

REFER ALSO TO CITATION(S) 20176, 20188, 21188, 21199, 21217, 21318, 21351

21220 (ANL—78-65(Pt.3), pp 44-46) **Influence of oxidation state on the sorption of plutonium by freshwater diatoms.** Nelson, D.M.; Kennedy, C.W.; Conway, H.L. 1978.

In Radiological and Environmental Research Division: ecology. Annual report, January-December 1978.

Biological uptake of Pu was investigated using two common freshwater diatoms species, Asterionella formosa and Fragilaria crotonensis, which were exposed to both oxidized (V + VI) and reduced (III + IV) plutonium. Results indicate that although plutonium in both oxidation states distributes throughout the cell, the oxidized form appears to cross the cell wall more rapidly than the reduced form. The plutonium found within the cells subsequent to the administration of the oxidized form was largely reduced, suggesting that cells may act as a reducing agent for plutonium in nature.

21221 (ANL—78-65(Pt.3), pp 55-57) **Sources of plutonium to the great Miami River.** Bartelt, G.E.; Kennedy, C.W.; Bobula, C.M. III. 1978.

In Radiological and Environmental Research Division: ecology. Annual report, January-December 1978.

Progress is reported in the study of ^{239}Pu, in the Great Miami River watershed the contribution of various sources to the total ^{239}Pu transported by the river. Periodic discharges of industrial wastewater from Mound Laboratory from 1973 to 1975 have released approximately 20 mCi of ^{239}Pu each year to the Great Miami River. Changes in the wastewater treatment system in 1976 have reduced the annual discharge to less than 3 mCi/year. However, despite this sevenfold reduction of plutonium in the wastewater discharge, the annual flux of ^{239}Pu down the river has remained relatively constant and is approximately 10 times greater than can be accounted for by the reported effluent discharges. Therefore, other sources of the ^{239}Pu in the Great Miami River exist. A second possible source of plutonium is the resuspension of sediments enriched by earlier waste water releases and deposited in the river. However, since there appear to be few areas where large accumulations of sediment could occur, it seems improbable that resuspension of earlier sediment deposits would continue to be a significant contributor to the annual flux of plutonium. A much more likely source is the continuing erosion of soil from a canal and stream system contaminated with ~ 5 Ci of ^{239}Pu, [7] which connects directly to the river 6.9 km upstream from Franklin. Results from samples analyzed in 1978 show the average concentration of ^{239}Pu in suspended sediments from the canal to be approximately 10^3 times greater than suspended sediment concentrations in the river and waste water effluent.Thus the main contributor to the total amount of plutonium transported by the Great Miami River appears to be highly enriched sediment from the canal, which is eroded into the river where it is then diluted by uncontaminated sediments.

21222 (ANL—78-65(Pt.3), pp 80-81) **Estimation of the contribution of sediment to the concentraton of plutonium in net phytoplankton samples.** Wahlgren, M.A.; Chase, E.M.; Alberts, J.J. 1978.

In Radiological and Environmental Research Division: ecology. Annual report, January-December 1978.

Previously reported studies showed that net plankton samples taken during the spring diatom bloom exhibited wet weight concentration factors for plutonium of five to ten thousand, and it was recognized that occluded mineral material might contribute to the apparent concentration of the net plankton samples. The contribution was believed to be minor since microscopic examination of many samples indicated little contamination by mineral particulates, and a strong correlation between the plutonium concentration factor and the silicon content of the samples was observed. Some recent experimental studies that tend to support the original conclusion are summarized. These results are consistent with the conclusions expressed in the earlier studies that the observed concentration factors for net plankton samples indicate considerable uptake of dissolved plutonium by phytoplankton, and that diatoms exhibit significantly higher concentration factors than other algae or their predators. (JGB)

THERMAL EFFLUENTS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 21207, 21223, 21332, 21335

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 20186, 21207

21223 (PB—80-100605) **Foothills Project: comments on inadequacies, environmental impact analyses and evaluation of alternative actions. Final report.** Stanford, J.A. (North Texas State Univ., Denton (USA). Dept. of Biological Sciences). Mar 1979. 20p. NTIS, PC A02/MF A01.

Important scientific literature which describes the limnology of the existing riverine environment, was overlooked in the preparation of statements concerning environmental impacts of the proposed action. The river in Waterton Canyon will be profoundly affected by construction of the Strontia Springs Dam. Downstream from the dam riverine environment will be characterized by compacted substrata (due to sluicing effect of discharge), luxurant growths of benthic algae (due to lack of sediment scour and presence of adequate growth nutrients), and depressed thermal regime (due to thermal stratification in the reservoir and hypolimnial release from the dam). Although a fishery may be sustained in the reservoir tailwaters, these changes should be considered as negative impacts in terms of the existing environment.

21224 (PB—80-103088) **Manufacturing water use requirements. Phase III, National Problem Analysis Second National Water Assessment.** (Water Resources Council, Washington, DC (USA)). 1977. 154p. NTIS, PC A08/MF A01.

The National Problem Analysis was the final analysis phase in the preparation of the Second National Water Assessment identifying and evaluating the Nation's most serious water resources problems. This chapter discusses water withdrawals and consumption by the manufacturing sectors.

21225 (PB—80-110802) **Nationwide analysis. Appendix M. Agricultural resources assessment system. Volume I.** (Water Resources Council, Washington, DC (USA)). Apr 1978. 271p. NTIS, PC A12/MF A01.

A comprehensive study was made to project the behavior of U.S. agriculture in 1985 and 2000 to provide a basis for estimating agricultural water needs and evaluate the impacts of regional water shortages. This was input to the 1975 National Water Assessment study sponsored by the U.S. Water Resources Council. A national linear programming model was used to estimate how farmers in various regions of the United States would use their land, water, labor and capital resources to meet domestic and export commodity demands in the future. Environment implications--soil erosion and effects on wildlife habitat--were also estimated.

REGULATIONS

REFER ALSO TO CITATION(S) 20745

21226 (C—1) **Guide to New Regulations for the NPDES Permit Program .** (Environmental Protection Agency, Washington, DC (USA)). Jun 1979. 30p. Environmental Protection Agency, Public Information Center (PM-215), 401 M Street, SW, Washington, DC.

This guide discusses the significant features of new final regulations governing the National Pollution Discharge Elimination System (NPDES) permit program. (DC)

21227 (C—2) **Guide to the Underground Injection Control Program.** (Environmental Protection Agency, Washington, DC (USA)). Jun 1979. 30p. Environmental Protection Agency, Public Information Center (PM-215), 401 M Street, SW, Washington, DC.

This Guide discusses the significant features of EPA's revised proposals for the Underground Injection Control Program under the Safe Drinking Water Act. The proposed technical criteria and standards were published on April 20, 1979, in the Federal Register (44 FR 23738) to be codified as Part 146 of Title 40, Code of Federal Regulations. Other pertinent requirements have been proposed as part of the Consolidated Permit Regulations intended as revisions to 40 CFR Parts 122, 123 and 124.

21228 (C—3) **Guide to the Proposed Consolidated Permit Regulations.** (Environmental Protection Agency, Washington, DC (USA)). Jun 1979. 21p. Environmental Protection Agency, Public Information Center (PM-215), 401 M Street, SW, Washington, DC.

This Guide discusses the proposed regulations consolidating the procedures which govern issuance of permits under four environmental statutes. The proposed regulations were published in the Federal Register on June 14, 1979. The 5 programs covered by the regulations are: the Hazardous Waste Management Program; the Underground Injection Control Program; the National Discharge Elimination Program; the Dredge or Fill Program; and the Prevention of Significant Deterioration Program. (DC)

21229 (C—4) **Guide for States on the Proposed Consolidated Permit Regulations.** (Environmental Protection Agency, Washington, DC (USA)). Jun 1979. 23p. Environmental Protection Agency, Public Information Center (PM-215), 401 M Street, SW, Washington, DC.

This guide discusses the proposed regulations consolidating the procedures which govern issuance of permits under 4 environmental statutes, as these new regulations pertain to state administration of those programs. The proposed regulations were published in the Federal Register on June 14, 1979. The programs covered by these regulations include: the Hazardous Waste Management Program; the Underground Injection Control Program; the National Pollutant Discharge Elimination System; Dredge or Fill Program; and the Prevention of significant Deterioration Program. (DC)

21230 (C—5) **Hazardous waste: a guide for obtaining permits and authorization for state programs.** (Environmental Protection Agency, Washington, DC (USA)). 1979. 27p. Environmental Protection Agency, Public Information Center (PM-215), 401 M Street, SW, Washington, DC.

This guide summarizes the regulations developed under sections 3005 and 3006 of the Resource Conservation and Recovery Act of 1976 and is intended to assist those directly involved with or affected by implementation of the regulations. Operators of hazardous waste management facilities seeking permits under section 3005 and states seeking authorization from the EPA Administrator to conduct a hazardous waste management program under section 3006 should find this guide helpful. (DC)

21231 (C—7) **Guide to the Consolidated Application Form.** (Environmental Protection Agency, Washington, DC (USA)). Jun 1979. 21p. Environmental Protection Agency, Public Information Center (PM-215), 401 M Street, SW, Washington, DC.

This guide outlines the major features of EPA's draft consolidated permit application form and proposed National Pollutant Discharge Elimination System (NPDES) regulations which were published in the Federal Register on June 14, 1979 (44 FR 34346). The consolidated application form will be used by permit applicants for the NPDES permit program, the Hazardous Waste Management permit program, the Underground Injection Control permit program, and the Prevention of Significant Deterioration permit program. The proposed NPDES regulations establish the way that the new application form will be used in the NPDES program and establish uniform application requirements among EPA and states authorized to operate NPDES programs.

ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

21232 **Workable methodology for evaluating socioeconomic and environmental impacts of energy conversion facilities at potential sites.** Northrop, G.M.; D'Ambra, C.A.; Scott, R.L. (Cent for the Environ and Man, Inc, Hartford, Conn). *Energy Technol. (Wash., D.C.);* **6**: 215-230(1979).

From 6. energy technology conference and exposition; Washington, DC, USA (26 Feb 1979).

A comprehensive outline of the Site Evaluation for Energy Conversion Systems Level I methodology is presented. A discussion is given of results obtained from nine hypothetical, illustrative applications involving nine energy conversion processes located at urban, suburban, and rural sites in the Eastern, Central, and Western regions of the US. It is shown that the SELECS methodology for determining socioeconomic and environmental impacts of energy conversion facilities at potential sites is comprehensive, orderly, easy to understand, and simple to apply. 7 refs.

SOCIAL AND ECONOMIC STUDIES

REFER ALSO TO CITATION(S) 20139, 21182, 21206, 21225

21233 (ANL/EES-TM—79) **Grain alcohol: the right product in the wrong market.** Alston, T.G.; Asbury, J.G. (Argonne National Lab., IL (USA)). 16 Mar 1980. Contract W-31-109-ENG-38. 8p. Dep. NTIS, PC A02/MF A01.

Due to the increased cost of petroleum products it is less expensive to produce ethanol from grain rather than petroleum based products. However, due to gasohol subsidies, grain alcohol is being prevented economically from entering the industrial chemicals market. Entry of grain alcohol into the industrial chemcials market would result in lower consumer prices in the long run. This aspect is discussed. (DC)

21234 (PB—80-101645) **Setting and achieving goals of ND-REAP (North Dakota-Regional Environmental Assessment Program).** Giddings, R.V.; Bond, V.F. (North Dakota Regional Environmental Assessment Program, Bismarck (USA)). 1979. 101p. NTIS, PC A06/MF A01.

The 1975 North Dakota Legislature established a legislative branch research and information program, the Regional Environmental Assessment Program (REAP). The concept of REAP is that of a comprehensive and integrated system for assessment of the impact of natural resource development on economic, social, and environmental parameters. The system was designed to serve primarily the legislature and state agencies; and, secondly, political subdivisions, federal agencies, private industry, institutions of higher education, and the public. Resolution of the following issues concerning REAP are reviewed: REAP as a scientific computing center; providing and developing services; adding staff vs. contractual agreements; charges; funding; geographical area of interest; scientific and technical activities; role with respect to state data; and service to state government. REAP's effort in issue identification and resolution identified problem areas that may be applicable to other states considering development of scientific and technological capabilities for state legislatures.

21235 (PB—80-113566) **Energy from the west: impact analysis report. Volume I: introduction and summary. Final report, July 1975-October 1979.** White, I.L.; Chartock, M.A.; Leonard, R.L.; Ballard, S.C.; Gilliland, M.W. (Oklahoma Univ., Norman (USA). Science and Public Policy Program). Mar 1979. Contract EPA-68-01-1916. 185p. NTIS, PC A09/MF A01.

This document reports the results of impact analyses conducted as a part of a three-year technology assessment of the development of six energy resources (coal, geothermal, natural gas, oil, oil shale and uranium) in eight western states (Arizona, Colorado, Montana, New Mexico, North Dakota, South Dakota, Utah and Wyoming) during the period 1975-2000. Volume I describes the purpose and conduct of the study and summarizes both site-specific and regional impact analysis results.

21236 (PB—80-113574) **Energy from the west: impact analysis report. Volume II: site-specific and regional impact analyses. Final report, July 1975-October 1979.** White, I.L.; Chartock, M.A.; Leonard, R.L.; Ballard, S.C.; Gilliland, M.W. (Oklahoma Univ., Norman (USA). Science and Public Policy Program). Mar 1979. Contract EPA-68-01-1916. 991p. NTIS, PC A99/MF A01.

This document reports the results of impact analyses conducted as a part of a three-year technology assessment of the development of six energy resources (coal, geothermal, natural gas, oil, oil shale and uranium) in eight western states (Arizona, Colorado, Montana, New Mexico, North Dakota, South Dakota, Utah and Wyoming) during the period 1975-2000. In Volume II, six chapters report on the analysis of the likely impacts of deploying typical energy resource development technologies at sites representative of the kinds of conditions likely to be encountered in the eight-state study area. A seventh chapter describes other local impacts which might occur; and a final chapter reports the results of regional impacts.

21237 Analysis of the sensitivities of local socioeconomic impacts to variations in the types and rates of coal development and differences in local site characteristics. Stenehjem, E.J.; Hoover, L.J.; Krohm, G.C. (Argonne National Lab., IL). pp 72-146 of Reclamation of disturbed arid lands. Wright, R.A. (ed.). Albuquerque, NM; University of New Mexico Press (1978).

From Symposium on reclamation of disturbed arid lands; Denver, CO, USA (20 Feb 1977).

Numerous studies have been conducted to predict the socioeconomic effects associated with site-specific coal development projects. The generic nature of most socioeconomic studies has been to forecast the employment and population impacts accompanying a specific energy technology at a particular site. Such forecasts have, in fact, become an important component of the environmental impact analyses of site-specific coal extraction and conversion activities. As a part of the Regional Studies Program being sponsored by the Administrator for Environmental and Safety of the Energy Research and Development Administration (ERDA), Argonne and several other national laboratories are conducting a National Coal Utilization Assessment (NCUA) to identify the problems associated with increased coal use and to analyze alternative mitigation strategies. This paper will serve as background for the Midwest regional assessment to be completed in July 1977, and the national assessment in December 1977. Using an approach developed at Argonne for use in its Regional Studies Program, the socioeconomic consequences accompanying alternative rates and types of coal development in a variety of potentially exploitable counties are projected. The results of these mini case studies are then used to evaluate the sensitivity of the projected impacts to the factors outlined above. By contrasting the socioeconomic consequences of identical coal technologies in counties having markedly different economic geographc, and demographic characteristics, the influences of preexisting conditions and infrastructure on the rate and magnitude of such impacts are described. Alternatively, the influences of different rates and types of coal development are evaluated by contrasting their anticipated socioeconomic consequences among nearly identical counties.

ASSESSMENT OF ENERGY TECHNOLOGIES

REFER ALSO TO CITATION(S) 20482, 20735, 20736, 21234

ENVIRONMENTAL IMPACT STATEMENTS

REFER ALSO TO CITATION(S) 20002

21238 Final environmental impact statement. Development of coal resources in southcentral Wyoming. Cheyenne, WY; Bureau of Land Management (1979). vp. (FES—79-15). Information Resources Press, 2100 M Street, NW, Suite 316, Washington, DC. (MC or HC) Order No. 79-0540.

In 3 volumes.

Development of federal coal resources in the 5.5-million-acre southcentral Wyoming region in Sweetwater and Carbon counties. Wyoming and Routt and Moffat counties, Colorado is proposed. Three mining and reclamation plans on existing leases would be approved. Eleven rights-of-way would be issued for support facilities, including 48.8 miles of new or relocated power transmission lines, 6.2 miles of railroad spur, 6.7 miles of relocated state highway, 1.6 miles of access and haul roads, and 3.4 miles of water pipeline.

21239 Final environmental impact statement. Proposed mining and reclamation plan, Pronghorn Mine, Campbell County, Wyoming. Denver, CO; Geological Survey (1979). 276p. (FES—79-13). Information Resources Press, 2100 M Street, NW, Suite 316, Washington, DC. (MC or HC) Order No. 79-0543.

Approval of Consolidation Coal Company's proposed 22-year mining and reclamation plan for the Pronghorn Mine in Campbell County, Wyoming is proposed. The leasehold is part of a state permit area. Mine facilities, a rail spur, and a 260-million-cubic-yard overburden and topsoil stockpile would be located within the boundaries of the state permit area but outside the lease boundaries. The coal would be mined by surface methods and transported by unit-trains to power plants for generation of electricity. When full production is achieved after four years of mining, reclamation of the land surface for future grazing and limited wildlife habitat would follow, with an average of 337 acres undergoing reclamation at any given time. Other proposed activities related to the plan include relocation of a county road and a 69-kilovolt (kV) powerline; construction of crushing and storage facilities for coal, a 28,000-square-foot building, and related facilities; and extension of a second 69-kV line to supply the surface facilities and mining equipment.

21240 Final environmental impact statement. Palo Verde-Devers 500-kV transmission line. Yuma, AZ; Bureau of Land Management (1979). 424p. (FES—79-12). Information Resources Press, 2100 M Street, NW, Suite 316, Washington, DC. (MC or HC) Order No. 79-0549.

Construction is proposed of a single-circuit 500-kilovolt (kV) transmission line and ancillary facilities between the Palo Verde Nuclear Generating Station near Buckeye, Arizona and Southern California Edison Company's Devers Substation near Palm Springs, California. Depending on the selected route, the line would be approximately 235 to 265 miles long and would traverse private and public lands. A main access road along the length of the right-of-way and spur roads connecting the main road with tower sites would be constructed.

21241 Final environmental impact statement. Operation of Watts Bar Nuclear Plant, Units 1 and 2. Washington, DC; Nuclear Regulatory Commission (1978). 234p. (NUREG—0498). Information Resources Press, 2100 M Street, NW, Suite 316, Washington, DC. (MC or HC) Order No. 79-0327.

Start-up and operation by the Tennessee Valley Authority of the Watts Bar Nuclear Plant Units 1 and 2 on the west shore of Chickamauga Reservoir in Rhea County, Tennessee are proposed. Each unit would employ a pressurized water reactor to produce up to 3411 megawatts thermal (MWt). This heat would be used to produce steam to drive steam turbines, providing 2340 megawatts electrical (MWe) of power capacity. The units would be cooled by cooling towers, with makeup water drawn from Chickamauga Reservoir.

21242 Final environmental impact statement. Cumulative production and consumption effects of the crude oil price incentive rulemakings. Washington, DC; Nuclear Regulatory Commission (1978). 779p. (DOE/EIS—0016). Information Resources Press, 2100 M Street, NW, Suite 316, Washington, DC. (MC or HC) Order No. 79-0929.

Implementation of Stage 2 price regulations pursuant to the Energy Policy and Conservation Act (EPCA) and the Energy Conservation and Production Act (ECPA) is proposed. Regulations are intended to ameliorate the impact of inflation and to provide additional price incentives for crude oil production. Stage 2 regulations would provide for monthly upward adjustments of the composite price, beginning in March 1976, to take into account the effects of inflation and to provide additional production incentives. Stage 3 regulations, which would provide special price incentives for tertiary oil recovery operations and other high-risk, high-cost oil production, are presently being developed. This statement also analyzes the impacts of the ECPA exemption of stripper well oil from price controls and its provision for special price treatment for heavy gravity crude oil produced in California and Alaska.

21243 Final environmental impact statement. Trimble County Generating Station, Trimble County, Kentucky: proposed issuance of a new source national pollutant discharge elimination system permit to Louisville Gas and Electric Company. Atlanta, GA; Environmental Protection Agency (1978). 615p. (EPA—904/9-78-017). Information Resources Press, 2100 M Street, NW, Suite 316, Washington, DC. (MC or HC) Order No. 79-0116.

Construction of a 2340-megawatt (MW) coal-fired, steam-electric-generating station, the Trimble County Generating Station, between Ohio river miles 570 and 572 or 0.5 miles upstream from Wises Landing in Trimble County, Kentucky, is proposed by the Louisville Gas and Electric Company. The project would require an 860-acre site for construction of two 495-MW generating units, one to be operational in 1983 and the other in 1985, and two 675-MW generating units, one to be operational in 1987 and the other in 1989. Other major components of the station would be two 735-foot-high stacks, two natural-draft cooling towers, a switchyard, two on-site disposal ponds, a barge-unloading facility, and water-intake and -discharge structures. The project also would require two ravines adjacent to the generating site, totalling 1440 acres, to be used for solid waste disposal. Two nine-mile-long, 345-kilovolt (kV) transmission lines would cross the Ohio River at the site and extend west into Clark County, Indiana to connect to a 138-kV line three miles west of New Washington, Indiana. The estimated total construction costs for the generating station and transmission system are $1,354 million.

21244 Final environmental impact statement. Proposed development of resources in southwestern Wyoming. Cheyenne, WY; Bureau of Land Management (1978). vp. (FES—78-20). Information Resources Press, 2100 M Street, NW, Suite 316, Washington, DC. (MC or HC) Order No. 78-1272.

In 3 volumes.

Development of federal coal resources in southwestern Wyoming by 1980, 1985, and 1990 is proposed. Five mining and reclamation plans on existing leases would be approved. Thirteen rights-of-way would be issued for support facilities related to the leases, comprising four rights-of-way for 19.9 miles of railroad spurs, three for 5.2 miles of road, five for 25.4 miles of power and telephone lines, and one for 2.5 miles of conveyor.

BIOMEDICAL SCIENCES, BASIC STUDIES

BEHAVIORAL BIOLOGY

REFER ALSO TO CITATION(S) 21279, 21295, 21335

21245 (ORNL/TM—7041) **Description of BRIND, a computer model of succession and fire response of the high altitude Eucalyptus forests of the Brindabella Range, Australian Capital Territory.** Noble, I.R.; Shugart, H.H.; Schauer, J.S. (Oak Ridge National Lab., TN (USA)). Apr 1980. Contract W-7405-ENG-26. 102p. Dep. NTIS, PC A06/MF A01.

The BRIND model, a computer model of the high altitude forests in the Brindabella Range near Canberra (Australian Capital Territory), is documented. The BRIND model simulates a 1/12-ha forest stand by computing the growth of each individual tree in the stand. It considers establishment and death of trees on a tree-by-tree basis using stochastic functions. The model also simulates the effects of prescribed fire and wildfire on the forests. The model currently is restricted to southeasterly facing slopes above 850 m in altitude. This report describes the model and documents the program. Testing of the model and the results are dicsussed elsewhere.

21246 **Life history of the bridgelip sucker in the central Columbia River.** Dauble, D.D. (Battelle Pacific Northwest Labs., Richland, WA). *Trans. Am. Fish. Soc.;* **109**: No. 1, 92-98(Jan 1980).

In the central Columbia River, southeastern Washington, bridgelip suckers (Catostomus columbianus) were common in deep water with strong currents during daylight and moved into slower shallow water at night. Mean calculated fork lengths (FL) in millimeters at annulus formation were age I, 63; II, 148; III, 224; IV, 291; V, 335; VI, 361; VII, 387; VIII, 401; IX, 408. Back calculated lengths approximated lengths at capture for respective ages. The length-weight (W) relationship for both sexes was log/sub e/W = -12.65 + 3.25 log/sub e/FL. Both sexes reached maturity at about 350 mm FL and age VI. Peak spawning in all years occurred during May in water temperatures of 8 to 13 C. Breeding males and females both exhibited a narrow red lateral line stripe. Estimated egg numbers per mature female ranged from 9,995 to 21,040. Bridgelip sucker diet was almost entirely periphyton, except fish smaller than 150 mm FL utilized mainly aquatic insect larvae and zooplankton. Variability of taxonomic characters caused some difficulty in distinguishing bridgelip suckers from sympatric largescale suckers (C. macrocheilus).

21247 **Sun compass orientation of immature bluegill.** Goodyear, C.P.; Bennett, D.H. (Savannah River Ecology Lab., Aiken, SC). *Trans. Am. Fish. Soc.;* **108**: No. 6, 555-559(Nov 1979).

Immature bluegills, Lepomis macrochirus (N = 389), were collected from Par Pond, a 1120-hectare impoundment on the United States Department of Energy's Savannah River Plant near Aiken, South Carolina, and tested individually by observing their directional movement from the center of a circular testing facility. Bluegills captured 10 to 20 m from shore in areas lacking extensive submerged vegetation swam in a direction which would have taken them to shore at the area of their capture, whereas those taken from areas have submerged vegetation offshore swam in the direction opposite from shore. The directional responses of fish that were phase-shifted by 6 hours demonstrated that they were using time-compensated sun orientation. Fish exposed to a predator oriented in the direction of shore in their training facility, but if no predators had been present during training, moved in the direction of deep water. Present evidence indicates that immature bluegills use their sun compass mechanism in oriented movements and that the observed behavior is probably related to avoidance of their predators.

21248 **Differential predation by the carnivorous marine copepod, Tortanus discaudatus.** Mullin, M.M. (Univ. of California, San Diego). Contract EY-76-C-03-0010. *Limnol. Oceanogr.;* **24**: No. 4, 774-777(Jul 1979).

The relative predation by adult, female Tortanus on their own naupliі and on developmental stages of Acartia clausii was determined by offering pairs of prey at several relative and absolute abundances. Predation was most intense on adult Acartia, less so on juvenile Acartia (naupliі and immature copepodites), and least on naupliar Tortanus. There was no evidence of switching.

BIOCHEMISTRY

REFER ALSO TO CITATION(S) 20993, 21265, 21276, 21280, 21299, 21347, 21348, 21360

21249 (LBL—10560) **Bacteriochlorophyll protein structure - studies with polarized light and triplet state electron paramagnetic resonance.** Bolt, J.D. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Feb 1980. Contract W-7405-ENG-48. 181p. Dep. NTIS, PC A09/MF A01.

Thesis.

Light harverting bacteriochlorophyll-protein complexes from Rhodopseudomonas sphaeroides 2.4.1 (B800 + 850) and R-26 (LH-R26) mutant are solubiliized in SDS and imbedded in polyvinyl alcohol. Stretching induces orientation, and the linear dichroism of visible and near infrared absorption is analyzed. Based on a simple model, angles between the particle axis system and the transition dipole moments are found. Reaction centers of the photosynthetic bacterium Rhodopseudomonas sphaeroides R-26, give rise to large triplet state EPR signals upon illumination at low temperature (11 K). Utilizing monochromatic polarized light to generate the EPR spectra (magnetophotoselection), it is shown that the intensities of the observed triplet signals are strongly dependent upon the wavelength and polarization direction of the excitation. Triplet states of carotenoids have been detected by EPR and are reported here for the first time. The systems in which carotenoid triplets are observed include cells of photosynthetic bacteria, isolated bacteriochlorophyll-protein complexes, and detergent micelles which contain β-carotene. The carotenoid triplet state is detected in reaction centers of Rhodopseudomonas sphaeroides 2.4.1 (wild type), which contain the carotenoid spheroidene.

21250 (SAND—80-0050C) **Charge transfer stabilization of hemoglobin structures.** Rousseau, D.L.; Shelnutt, J.A.; Friedman, J.M.; Henry, E.R.; Simon, S.R. (Bell Labs., Murray Hill, NJ (USA); Princeton Univ., NJ (USA). Dept. of Physics; State Univ. of New York, Stony Brook (USA). Dept. of Biochemistry). 1980. Contract EY-76-C-04-0789. 5p. (CONF-800508—1). Dep. NTIS, PC A02/MF A01.

From 2. biophysical meeting on proteins and nucleoproteins: structure, dynamics, and assembly; Airlie, VA, USA (19 May 1980).

The porphyrin macrocycle in heme proteins is embedded in a hydrophobic pocket. Although it is clear that many functional properties of heme proteins are governed by the interaction between the heme and its local environment, the detailed nature of these forces has not been explored. We have recently developed a highly sensitive Raman difference spectroscopy to assess the importance of such forces by studying perturbations on the heme due to changes in this protein environment. Application of this technique to ferrous deoxyhemoglobins with quaternary structures stabilized by chemical modification of the proteins yields Raman frequency differences which correlate with conformational stabilization. Similarly, changes are observed in certain Raman modes when the allosteric effector, IHP, is added to methemoglobins. These data provide evidence for an electronic stabilization between the heme and the protein.

21251 **Analytical techniques for cell fractions.** Pearson, T.; Anderson, L. (Argonne National Lab., IL). *Anal. Biochem.;* **101**: No. 2, 377-386(15 Jan 1980).

Disposable microimmunoadsorbent columns containing Staphylococcus Protein A and monoclonal antibodies were used to bind antigenic proteins from a mixture. Eluates from these columns were directly analyzed by electrophoresis on two-dimensional (2-D) gels. In this way, biochemical and biophysical information on the bound antigen and on the specific antibody can be obtained simultaneously. The microimmunoadsorbents are easy to handle and in conjunction with multiple 2-D gel systems provide a means for screening large numbers of myeloma hybrids for specificity to antigens in complex mixtures.

21252 **Enzymology of L-tyrosine biosynthesis in mung bean (Vigna radiata [L.] Wilczek).** Rubin, J.L.; Jensen, R.A. (State Univ. of New York, Binghamton). Contract EP-78-S-02-4967. *Plant Physiol.;* **64**: No. 5, 727-734(Nov 1979).

The enzymes of the 4-hydroxyphenylpyruvate (prephenate dehydrogenase and 4-hydroxyphenylpyruvate aminotransferase) and pretyrosine (prephenate aminotransferase and pretyrosine dehydrogenase) pathways of L-tyrosine biosynthesis were partially purified from mung bean (Vigna radiata [L.] Wilczek) seedlings. NADP-dependent prephenate dehydrogenase and pretyrosine dehydrogenase activities coeluted from ion exchange, adsorption, and gel-filtration columns, suggesting that a single protein (52,000 daltons) catalyzes both reactions. The ratio of the activities of partially purified prephenate to pretyrosine dehydrogenase was constant during all purification steps as well as after partial inactivation caused by p-hydroxymercuribenzoic acid or heat. The activity of prephenate dehydrogenase, but not of pretyrosine dehydrogenase, was inhibited by L-tyrosine at nonsaturating levels of substrate. The K/sub m/ values for prephenate and pretyrosine were similar, but the specific activity with prephenate was 2.9 times greater than with pretyrosne. Two peaks of aromatic aminotransferase activity utilizing L-glutamate or L-aspartate as amino donors and 4-hydroxyphenylpyruvate, phenylpyruvate, and/or prephenate as keto acid substrates were eluted from DEAE-cellulose. Of the three keto acid substrates, 4-hydroxyphenylpyruvate was preferentially utilized by 4-hydroxyphenylpyruvate aminotransferase whereas prephenate

was best utilized by prephenate aminotransferase. The identity of a product of prephenate aminotransferase as pretyrosine following reaction with prephenate was established by thin layer chromatography of the dansyl-derivative.

21253 Biochemical applications of a synchronously pumped krypton ion dye laser fluorescence system. Richardson, J.H.; Steinmetz, L.L.; Deutscher, S.B.; Bookless, W.A.; Schmelzinger, W.L. (Univ. of California, Livermore). Contract W-7405-ENG-48. *Anal. Biochem.;* **97**: No. 1, 17-23(Aug 1979).

From 176. American Chemical Society national meeting; Miami Beach, FL, USA (11 Sep 1978).

A synchronously pumped krypton ion dye laser fluorescence system is shown to provide tunable, polarized, subnanosecond pulses at high repetition rates, modest peak powers, and low energy. Such a source is uniquely suited to fluorescence investigations of biochemical mechanisms. Applications of this fluorescence excitation source to analysis, lifetime determination, and depolarization effects are discussed.

21254 Simultaneous measurement of fluorescence and phosphorescence using synchronously gated photon counters. Sutherland, J.C.; Cimino, G.D.; Desmond, E.J. (Brookhaven National Lab., Upton, NY). *Anal. Biochem.;* **97**: No. 1, 158-165(Aug 1979).

The fluorescence (prompt emission) and phosphorescence (delayed emission) from a sample can be separated and recorded simultaneously by digital processing of the photon-induced electronic pulses they generate. A single rotating sector wheel (or chopper) periodically interrupts the beam of radiation incident upon the sample. Both prompt and delayed emissions from the sample pass through the same optical system to a photomultiplier. The electronic pulses they generate are processed by the same amplifiers and discriminator. Separation of the prompt and delayed components is a two-stage process. Pulses produced while the chopper is blocking the exciting beam are stored in one counter, the contents of which are a measure of the delayed emission. Pulses produced while the chopper is open are stored in another counter. The contents of this counter represent contributions of both prompt and delayed emissions. The contents of both counters are transferred to a computer for postexperimental deconvolution of the fluorescence and phosphorescence. Since the two components are measured simultaneously, the ratio of phosphorescence to fluorescence cannot be affected by changes in the sample as with sequential scans. The optical path, electronic amplification, and gating periods are identical so fluorescence and phosphorescence are measured with equal efficiency. This two-step method of signal processing recovers data which are lost in other arrangements.

21255 Inactivation of hydrogenase in cell-free extracts and whole cells of Chlamydomonas reinhardi by oxygen. Erbes, D.L.; King, D.; Gibbs, M. (Brandeis Univ., Waltham, MA). Contract EY-76-S-02-2331-14. *Plant Physiol.;* **63**: No. 6, 1138-1142(Jun 1979).

O_2 irreversibly inactivates hydrogenase from Chlamydomonas reinhardi. The mechanism for the inactivation involves the reaction of one molecule of hydrogenase with one molecule of O_2 (or two oxygen atoms) in the transition complex of the rate-limiting step. The second order rate constant for this reaction is 190 atmospheres^{-1} minute^{-1} (1.4×10^5 molar^{-1} minute^{-1}). At levels above 0.01 atmospheres O_2, the increased numbers of O_2 molecules may compete for the site of inactivation hindering the proper orientation for inactivation of any one O_2 molecule and resulting in lowered rates of inactivaton. CO is a reversible inhibitor of hydrogenase acting competitively against H_2. The K/sub i/ for CO is 0.0010 atmosphere. CO antagonizes O_2 inactivation. In a period when complete inactivation by O_2 would usually occur, the presence of CO greatly reduces the inactivation rate. After 3 hours of adaptation in whole cells, the presence of H_2 lowers the rate of deadaptation of hydrogenase. Inasmuch as H_2 promotes increased O_2 uptake the cellular conentration of O_2 is likely to be lower. After 48 hours of adaptation O_2 uptake is reduced even when H_2 is present and the pattern of deadaptation under O_2 with and without H_2 and CO is qualitatively the same as observed for the inactivation of cell-free hydrogenase. The mechanism of inactivation of cell-free hydrogenase by O_2 may be the same as the mechanism for loss of hydrogenase during deadaptation in whole algal cells.

21256 Free radical mechanisms of lipid damage and consequences for cellular membranes. Mead, J.F. pp 51-67 of Free radicals in biology. Vol. I. Pryor, W.A. (ed.). New York, NY; Academic Press Inc. (1976).

The role of free radicals in autoxidative damage to lipids in membranes is discussed. The chemistry of lipid oxidation is presented. The formation of free radicals in lipid membranes in vitro and in vivo is discussed.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 21277, 21300, 21301, 21302, 21336, 21355

21257 Reaction of 3-diazonium-1,2,4-triazole with tryptophan at acid pH: a scintillation method for tryptophan determination in proteins. DeTraglia, M.C.; Brand, J.S.; Tometsko, A.M. (Univ. of Rochester Medical Center, NY). Contract EY-C-02-3490. *Anal. Biochem.;* **99**: No. 2, 464-473(1 Nov 1979).

Unlike conventional aryl diazonium reagents which are usually reactive at alkaline pH, 3-diazonium-1,2,4-triazole (3-DT) has been found to react with a variety of proteins at acid pH. Using indole, phenol, and imidazole as models of aromatic amino acid side chains, the rate of 3-DT coupling to the indole nucleus has been shown to increase exponentially from < 200 M^{-1} min^{-1} at pH 6 to > 2400 M^{-1} min^{-1} at pH 2.5. Coupling rates with phenol and imidazole show the conventional alkaline reactivity, with no evidence of reaction at acid pH. In parallel experiments using trypsin, 3-DT was found to cause loss in enzymatic activity at acidic as well as alkaline pH. Furthermore, amino acid analysis has demonstrated that the acidic reaction with trypsin resulted in the modification only of tryptophan. Based on the acidic specificity of 3-DT seen in these studies, a scintillation method for determining the tryptophan content of proteins has been developed. Using 3-diazonium-1,2,4-[5-^{14}C]triazole, accurate tryptophan contents for trypsin, chymotrypsin, lysozyme, pepsin, insulin, and fibrinogen have been measured.

21258 New methods for the purification of vertebrate vitellogenin. Wiley, H.S.; Opresko, L.; Wallace, R.A. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Anal. Biochem.;* **97**: No. 1, 145-152(Aug 1979).

Two procedures are described for the isolation of vitellogenin from plasma. Vitellogenin can be selectively precipitated from the plasma of estrogen-treated animals by Mg^{2+} in the presence of EDTA. The vitallogenin thus obtained is $> 99\%$ pure and is relatively undegraded. In the second procedure, vitellogenin can also be isolated by DEAE-cellulose chromatography, resulting in preparations that contain $< 2\%$ albumin. In combination, these two isolation procedures yield vitellogenin preparations of very high purity.

21259 Hydrolytic enzymes in the central vacuole of plant cells. Boller, T.; Kende, H. (Michigan State Univ., East Lansing). Contract EY-76-C-02-1338. *Plant Physiol.;* **63**: No. 6, 1123-1132(Jun 1979).

The hydrolase content of vacuoles isolated from protoplasts of suspension-cultured tobacco cells, of tulip petals, and pineapple leaves, and the sedimentation behavior of tobacco tonoplasts were studied. Three precautions were found to be important for the analysis of vacuolar hydrolases and of the tonoplast: (a) purification of protoplasts in a Ficoll gradient was necessary to remove cell debris which contained contaminating hydrolases adsorbed from the fungal cell-wall-degrading enzyme preparation; (b) hydrolase activities in the homogenates of the intact cells or the tissue used and of the purified protoplasts had to be compared to verify the absence of contaminating hydrolases in the protoplast preparation; and (c) vacuoles obtained from the protoplasts by an osmotic shock had to be purified from the lysate in a Ficoll gradient. Since the density of the central vacuole approximates that of the protoplasts, about a 10% contamination of the vacuolar preparation by surviving protoplasts could not be eliminated. The intracellular activities of the following acid hydrolases were primarily localized in the vacuole of tobacco cells: α-mannosidase, β-N-acetylglucosaminidase, β-fructosidase, nuclease, phosphatase, phosphodiesterase. A similar composition of acid hydrolases was found in vacuoles obtained from protoplasts of tulip petals. Proteinase, a hydrolase with low activity in tobacco cells and tulip petals was found to be vacuolar in pineapple leaves, a tissue containing high levels of this enzyme. None of the vacuolar enzymes investigated ws found to be bound to the tonoplast. When vacuoles were isolated from cells labeled with radioactive choline, the vacuolar membrane was found to contain radioactivity. On sucrose gradients, the label incorporated into tonoplasts banded around a density of 1.10 grams per cubic centimeter (24% sucrose, w/w).

21260 β-1,3-glucan in developing cotton fibers. Maltby, D.; Carpita, N.C.; Montezinos, D.; Kulow, C.; Delmer, D.P. (Michigan State Univ., East Lansing). Contract EY-76-C-02-1338. *Plant Physiol.;* **63**: No. 6, 1158-1164(Jun 1979).

Evidence is presented for the existence of a noncellulosic β-1,3-glucan in cotton fibers. The glucan can be isolated as distinct fractions of varying solubility. When fibers are homogenized rigorously in aqueous buffer, part of the total β-1,3-glucan is found as a soluble polymer in homogenates freed of cell walls. The proportion of total β-1,3-glucan which is found as the soluble polymer varies somewhat as a function of fiber age. The insoluble fraction of the B-1,3-glucan remains associated with the cell wall fraction. The glucan fraction which can be isolated as a soluble polymer in homogenates freed of cell walls is not associated with membranous material, and we propose that it represents glucan which is also extracellular but not tightly associated with the cell wall. Enzyme digestion studies indicate that all of the cotton fiber glucan is β-linked, and methylation analyses and enzyme studies both show that the predominant

linkage in the glucan is 1 → 3. The possibility of some minor branching at C-6 can also be deduced from the methylation analyses. The timing of deposition of the β-1,3-glucan during fiber development coincides closely with the onset of secondary wall cellulose synthesis. Kinetic studies performed with ovules and fibers cultured in vitro show that incorporation of radioactivity from [^{14}C/glucose into β-1,3-glucan is linear with respect to time almost from the start of the labeling period; however, a lag is observed before incorporation into cellulose becomes linear with time, suggesting that these two different glucans are not polymerized directly from the same substrate pool. Pulse-chase experiments indicate that neither the β-1,3-glucan nor cellulose exhibits significant turnover after synthesis.

CYTOLOGY

21261 (LA—8269-MS) **Flow Systems Newsletters, 1978-1979.** Jett, J.H. (ed.). (Los Alamos Scientific Lab., NM (USA)). Mar 1980. Contract W-7405-ENG-36 . 58p. Dep. NTIS, PC A04/MF A01.

The purpose of the Newsletter is to provide a means of rapid communication among interested investigators in the fields of biology, medicine and instrumental development who use the powerful techniques of flow cytometry and cell sorting. The Newsletter is entirely dependent upon contributions from readers for its content. Those contributions fall into the categories of abstracts of papers accepted for publication, research notes, research questions, positions desired, positions available, and announcements of general interest to the flow community. In this report, the eight Newsletters issued during 1978-1979 are compiled.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 21336, 21355

GENETICS

REFER ALSO TO CITATION(S) 21337

21262 (DOE/EV/3264—18) **Improved mutagen-testing systems in mice. Progress report, 1 September 1978-30 October 1979.** Roderick, T.H. (Jackson Lab., Bar Harbor, ME (USA)). 1 Nov 1979. Contract EY-76-S-02-3267. 9p. Dep. NTIS, PC A02/MF A01.

The purpose of this project is to produce improved mutagen-testing systems in mice. Our approach is to produce chromosomal inversion systems and to improve the techniques necessary to induce, detect, genetically define, and combine inversions in effective useful mutation-test systems. Another specific objective has been to test the systems produced with respect to their effectiveness. Another objective has been to mark, maintain, and study recessive detrimentals and lethals induced in the validation-testing of these systems. Of particular importance is to study induced recessives for dominant effects on fitness. A final broad objective has been to use the induced inversions and recessive lethals for studies of basic problems in mammalian genetics, growth, and development.

METABOLISM

REFER ALSO TO CITATION(S) 21275, 21280, 21347, 21348, 21360

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 21257, 21355

MEDICINE

REFER ALSO TO CITATION(S) 20227

21263 (LBL—10022) **Biology and Medicine Division annual report, 1978-1979.** (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1979. Contract W-7405-ENG-48. 128p. Dep. NTIS, PC A07/MF A01.

Summaries of research projects conducted during 1978 and 1979 are presented. Subject areas include research medicine, cancer research, environmental physiology, radiation biophysics, and structural biophysics. (ACR)

21264 **Electrosurgical knife.** Doss, J.D.; Cowan, R.E.; Newell, R.H.; McCabe, C.W. (to Dept. of Energy). US Patent 4,161,950. 24 Jul 1979. Filed date 1 Aug 1975. 4p.

PAT-APPL-601,113.

An electrosurgical knife blade of insulating material having a pair of electrodes adapted to be connected to a radiofrequency generator is described.

21265 **Erythrocyte enzyme deficiencies assessed with a miniature centrifugal analyzer.** Fielek, S.; Mohrenweiser, H.W. (Univ. of Michigan, Ann Arbor). *Clin. Chem.;* **25**: No. 3, 384-388(Mar 1979).

Methods for assaying 16 erythrocyte enzymes have been adapted to the miniature centrifugal analyzer. Less than 15 μL of whole blood is required for all 16 assays. Variation attributable to temporal effects, rotor effects, and random residual error is minor. Initial population studies of blood from adults and cord-blood samples suggest a CV of <12% for 12 of the 16 enzymes; thus it should be possible to identify the heterozygous deficient individual. Preliminary data suggest that three such individuals, with enzyme activity (adenylate kinase, pyruvate kinase, phosphoglycerate kinase) about half the expected, have been identified, as well as two individuals deficient in glucose-6-phosphate dehydrogenase.

UNSEALED RADIONUCLIDES IN DIAGNOSTICS

REFER ALSO TO CITATION(S) 20996, 21325, 21326, 21329

21266 (AD-A—073106) **A computerized method for determination of regional blood flow using radioactive tracer microspheres. Technical report.** Smith, K.C.; Ward, S.; Greenlees, K.J.; Oloff, C.M. (Aerospace Medical Research Lab. (6570th), Wright-Patterson AFB, OH (USA)). Mar 1979. Contract F33615-76-C-5001. 42p. NTIS, PC A03/MF A01.

Studies utilizing radioactive tracer microspheres to determine blood flow to a specific region, tissue, or organ under +G sub z acceleration were done in this Laboratory. The microspheres were injected into animal subjects and were distributed throughout the body. They were trapped in capillary beds according to size. Tissue samples from areas of interest were taken, and radiation measured. A computer program was developed to calculate corrected counts per minute, regional blood flow, and cardiac output from raw data. This report includes a brief outline of the experimental design, the theory behind the program, execution of the program, and the program listing.

21267 **Automated radioimmunoassay of nicotine.** Castro, A.; Monji, N.; Malkus, H. (Miami Univ., FL (USA). Dept. of Pathology); Eisenhart, W. (Union Carbide Corporate Research, Tarrytown, NY (USA)); Mckennis, H.Jr.; Bowman, E.R. (Medical Coll. of Virginia, Richmond (USA)). *Clin. Chim. Acta;* **95**: No. 3, 473-481(1 Aug 1979).

The authors have developed an automated nonequilibrium procedure for the radioimmunoassay of nicotine. The use of a unique iodinated nicotine derivative in this procedure gave a sensitivity of 10 μg/l for nicotine with a between-run precision of 7.4% and within-run precision of 6.0%. Nicotine levels of 60 to 67 μg/l were found in subjects 15 min after smoking one standard cigarette. The technique herein reported is a very rapid, and sensitive radioimmunoassay for nicotine and facilitates the determination of nicotine in smoking subjects during the actual process of smoking.

21268 (ORNL/TM—7223) **Nuclear medicine technology progress report for quarter ending December 31, 1979.** Knapp, F.F. Jr. (Oak Ridge National Lab., TN (USA)). Apr 1980. Contract W-7405-ENG-26. 27p. Dep. NTIS, PC A03/MF A01.

Platinum-195m-labeled cis-dichloro-trans-dihydroxy-bis-(isopropylamine)-platinum(IV) (CHIP) was prepared for the first time. This second-generation platinum antitumor agent appears superior to the widely used cis-dichloro-diammineplatinum(II) (cis-DDP) since the dose-limiting nephrotoxicity associated with cis-DDP therapy is not encountered. Platinum-195m-labeled CHIP is being used to determine the tissue-distribution, excretion, and other pharmacological properties of this new drug. Studies of the heart uptake in rats of ^{75}Se and /sup 123m/Te-labeled long-chain fatty acids have continued. The greater heart uptake of /sup 123m/Te-9-telluraheptadecanoic acid compared with the selenium analog, ^{75}Se-9-selenaheptadecanoic acid, was confirmed. Radiation dose estimates for a new adrenal imaging agent, /sup 117m/Sn-23-(trimethylstanna)-24-nor-5α-cholan-3β-ol (23-TSC) have been completed. Tissue distribution and excretion data for /sup 117m/Sn-23-TSC were used to extrapolate the radiation dose values to humans. The calculated radiation dose values for /sup 117m/Sn-23-TSC are: adrenals, 83 rads/mCi; total body, 0.77 rad/mCi/; and ovaries, 4.4 rads/mCi. These values are considerably lower than similar estimates for a variety of other radiolabeled steroids and suggest that /sup 117m/Sn-23-TSC may be an attractive new agent for adrenal visualization in humans. The diffusion chamber assay system has been further assessed as a technique to determine the toxicity of As_2O_3 administration on the proliferation of cells within chambers implanted in the peritoneal cavities of rats and hamsters. Both human embryonic lung cells and human nasopharyngeal carcinoma cells were used in the studies.

21269 (PB—80-101405) **Quality assurance for radiographic x-ray units and associated equipment.** Hendee, W.R.; Rossi, R.P. (Colorado Univ., Denver (USA). Medical Center). Aug 1979. Contract FDA-AD-39. 119p. NTIS, PC A06/MF A01.

The manual provides detailed quality assurance procedures for general purpose radiographic equipment and ancillary equipment, such as intensifying screens, cassettes, and view boxes. Included is data analysis techniques and recommendations for taking corrective measures. The procedures described in this manual are based on the procedures and equipment used by the contractor. Comparable equipment from other manufacturers may serve equally well in performance of these tests.

21270 (PB—80-102833) **Radioimmunoassay for the quantitative determination of human anti-meningococcal antibodies. Annual report 1 Feb 78-30 Apr 79.** Gotschlich, E.C. (Rockefeller Univ., New York (USA)). 1 May 1979. Contract N01-AI-12502. 5p. NTIS, PC A02/MF A01.

During the last year of contract support, we have performed a large number of antibody determinations on sera of children vaccinated with Group A or Group C meningococcal polysaccharide. In addition, a number of sera from monkeys vaccinated with different preparations of Group C were also studied. These sera were provided through the efforts of the staff of NIAID and also from other sources.

21271 **Effect of structural modifications on the adrenal uptake of steroids labeled in the side chain with tellurium-123m.** Knapp, F.F. Jr.; Ambrose, K.P.; Callahan, A.P. (Oak Ridge National Lab., TN). *J. Nucl. Med.;* **21**: No. 3, 258-263(Mar 1980).

A series of structurally modified steroids labeled in the side chain with Te-123m have been prepared and tested in rats to determine the critical structural features required for maximal adrenal uptake of this new class of potential adrenal-imaging agents. The Te-123m steroids investigated contained structural modifications of both the nucleus and side chain. Tissue distribution experiments and rectilinear scans indicated that 23-(isopropyl telluro)-24-nor-5α-cholan-3β-ol (saturated nucleus), and 24-(isopropyl telluro)-chol-5-en-3β-ol (nuclear double bond) showed pronounced adrenal uptake after 1 day, with adrenal-to-liver ratios of 41 and 27, respectively. These results indicate that a combination of structural features is required for significant adrenal uptake of steroids labeled in the side chain with Te-123m. The structural requirements include a trans ring structure, an equatorial C-3 hydroxyl group, and a 17β side chain of moderate length.

EXTERNAL RADIATION IN DIAGNOSTICS

21272 (PB—80-102445) **Analysis of retakes: understanding, managing, and using an analysis of retakes program for quality assurance.** Goldman, L.W.; Beech, S. (Bureau of Radiological Health, Rockville, MD (USA)). Aug 1979. 49p. NTIS, PC A03/MF A01.

The manual describes in detail how to implement a retake collection and analysis study, and how this data may be used to augment a Quality Control program. It includes data analysis techniques as well as instructions and examples for calculating the cost of retakes in each individual facility.

EXTERNAL RADIATION IN THERAPY

REFER ALSO TO CITATION(S) 21292

21273 **Optimization of radiotherapy.** Mendelsohn, M.L. (Univ. of California, Livermore). *Int. J. Radiat. Oncol., Biol. Phys.;* **5**: No. 10, 1923-1924(Oct 1979).

A method of radiotherapy performance evaluation (TC, treatment characteristic) is discussed having two requirements - assessment of local control and complications and a minimum of two treatment intensities. Optimization of the radiotherapy should be planned with the limits of complications and patient tolerance in mind.

UNSEALED RADIONUCLIDES IN THERAPY

REFER ALSO TO CITATION(S) 21273, 21450

MICROBIOLOGY

REFER ALSO TO CITATION(S) 20132, 20321, 21249

21274 **Assessment of microbial fouling in an ocean thermal energy conversion experiment.** Aftring, R.P.; Taylor, B.F. (Univ. of Miami, FL). *Appl. Environ. Microbiol.;* **38**: No. 4, 734-739(Oct 1979).

A project to investigate biofouling, under conditions relevant to ocean thermal energy conversion heat exchangers, was conducted during July through September 1977 at a site about 13 km north of St. Croix (US Virgin Islands). Seawater was drawn from a depth of 20 m, within the surface mixed layer, through aluminum pipes (2.6 m long, 2.5-cm internal diameter) at flow velocities of about 0.9 and 1.8 m/s. The temperature of the seawater entering the mock heat exchanger units was between 27.8 and 28.6°C. After about 10 weeks of exposure to seawater, when their thermal conductivity was reported to be significantly impaired, the pipes were assayed for the accumulation of biological material on their inner surfaces. The extent of biofouling was very low and independent of flow velocity. Bacterial populations were about 10^7 cells per cm^2. The ranges of mean areal densities for other biological components were: organic carbon, 18 to 27 $\mu g/cm^2$; organic nitrogen, 1.5 to 3.0 $\mu g/cm^2$; adenosine 5'-triphosphate, 4 to 28 ng/cm^2; carbohydrate (as glucose in the phenol assay), 3.8 to 7.0 $\mu g/cm^2$; chlorophyll a, 0.2 to 0.8 ng/cm^2. It was estimated from the adenosine 5'-triphosphate and nitrogen contents that the layer of live bacteria present after 10 weeks was only of the order of 1 μm thick. The C/N ratio of the biological material suggested the presence of extracellular polysaccharidicmaterial. Such compounds, because of their water-retaining capacities, could account for the related increase in thermal resistance associated with the pipes.

21275 **Comparative effects of Aroclor 1254 (polychlorinated biphenyls) and phenanthrene on glucose uptake by freshwater microbial populations.** Sayler, G.S.; Lund, L.C.; Shiaris, M.P.; Sherrill, T.W.; Perkins, R.E. (Univ. of Tennessee, Knoxville). *Appl. Environ. Microbiol.;* **37**: No. 5, 878-885(May 1979).

The effects of polychlorinated biphenyl (PCB) and phenanthrene stress on glucose uptake by natural microbial populations were examined by the heterotrophic potential technique. Temporal and spatial distributions in glucose uptake velocities were examined for natural samples as well as PCB- and phenanthrene-stressed samples. Statistical analysis indicated significant variability among the various samples. It was demonstrated that the environmental variables contributed significantly to the variability in uptake kinetics. Although general trends indicated a PCB-induced stimulation in uptake velocities, these trends were in part masked by sample variability. Data analysis indicated no statistically significant PCB or phenanthrene effect on either total glucose uptake velocities or the proportion of $^{14}CO_2$ evolved, as compared to natural unstressed samples.

21276 **Picosecond and steady state, variable intensity and variable temperature emission spectroscopy of bacteriorhodopsin.** Shapiro, S.L. (Los Alamos Scientific Lab., NM); Campillo, A.J.; Lewis, A.; Perreault, G.J.; Spoonhower, J.P.; Clayton, R.K.; Stoeckenius, W. *Biophys. J.;* **23**: No. 3, 383-393(Sep 1978).

The bacteriorhodopsin emission lifetime at 77°K has been obtained for different regions of the emission spectrum with single-pulse excitation. The data under all conditions yield a lifetime of 60 +- 15 ps. Intensity effects on this lifetime have been ruled out by studying the relative emission amplitude as a function of the excitation pulse energy. We relate our lifetime to previously reported values at other temperatures by studying the relative emission quantum efficiency as a function of temperature. These variable temperature studies have indicated that an excited state with an emission maximum at 670 nm begins to contribute to the spectrum as the temperature is lowered. Within our experimental error the picosecond data seem to suggest that this new emisson may arise from a minimum of the same electronic state responsible for the 77°K emisson at 720 nm. A correlation is noted between a 1.0-ps formation time observed in absorption by Ippen et al., (Ippen, E. P., C. V. Shank, A. Lewis, and M. A. Marcus, 1978. Subpicosecond spectroscopy of bacteriorhodopsin, Science [Washington, DC], 200:1279-1281] and a time extrapolated from relative quantum efficiency measurements and the 77°K fluorescence lifetime that we report.

TRACER TECHNIQUES

21277 **Rapid DEAE disk assay for photoreactivation of pyrimidine dimers in [^{3}H]DNA.** Farland, W.H.; Sutherland, B.M. (Brookhaven National Lab., Upton, NY). *Anal. Biochem.;* **97**: No. 2, 376-381(1 Sep 1979).

We have developed a rapid, sensitive, and specific assay for photoreactivation of pyrimidine dimers in ^{3}H-labeled DNA. It is based on the nuclease resistance of dimer-containing sequences in DNA, and the adsorption of these sequences to DEAE-substituted paper (DE-81). The method maintains the advantages of the rapid dimer assay of B.M. Sutherland and M.J. Chamberlin (1973, Anal. Biochem., 53, 168-176), while avoiding its major drawback, the frequent preparation of high specific activity, ^{32}P-labeled, bacteriophage DNA. In addition, the use of scintillation spectrometry in our assay should allow more widespread use of this method.

MORPHOLOGY

REFER ALSO TO CITATION(S) 21246

21278 (LASL—79-58) **Golden hamster: quantitative anatomy with age.** Thomas, R.G.; London, J.E.; Drake, G.A.; Jackson, D.E.; Wilson, J.S.; Smith, D.M. (Los Alamos Scientific Lab., NM (USA)). Oct 1979. Contract W-7405-ENG-36. 125p. Dep. NTIS, PC A06/MF A01.

The Syrian (golden) hamster, Mesocricetus auratus, is used widely in biomedical research, particularly in experimental carcinogenesis. The data presented here, a relatively complete addition to data already in print, give standard values for tissues and blood components for the conditions at the Los Alamos Scientific Laboratory (LASL) in Los Alamos, New Mexico. This study delineates median values for the tissues and blood parameters versus the time from weaning through 18 months of age.

21279 **Biology of the sand roller in the central Columbia River.** Gray, R.H.; Dauble, D.D. (Battelle Pacific Northwest Labs., Richland, WA). *Trans. Am. Fish. Soc.;* **108**: No. 6, 646-649(Nov 1979).

The sand roller, Percopsis transmontana, is endemic to the Columbia River and its tributaries. The species occurs at depths to 4 m over rock and sand bottom at temperatures of 2.5 C in winter to 20.5 C in summer. The fork length (FL, mm)-weight (W, g) relationship of the sand roller is log/sub e/W = 10.65 + 2.91 log/sub e/FL. Sand rollers attain at least age VI and 103 mm FL. Fish growth is greatest during the first year of life and declines after maturity at age II to III. Spawning occurs in midsummer. Aquatic insect larvae (mainly Diptera and Trichoptera) are the major food items, but crustacean zooplankton constitute a greater portion of the diet of immature fish less than 40 mm FL.

21280 **Cell surfaces in plant-microorganism interactions. I. A structural investigation of cell wall hydroxyproline-rich glycoproteins which accumulate in fungus-infected plants.** Esquerre-Tugaye, M.T. (Universite Paul Sabatier, Toulouse, France); Lamport, D.T.A. *Plant Physiol.;* **64**: No. 2, 314-319(Aug 1979).

Infection of muskmelon Cucumis melo seedlings by the fungus Colletotrichum lagenarium causes a 10-fold increase in the amount of cell wall hydroxyproline-rich glycoprotein. Evidence for this increase was provided by studying two specific markers of this glycoprotein, namely hydroxyproline and glycosylated serine. The lability of the O-glycosidic linkage of wall-bound glycosylated serine in the presence of hydrazine was used to determine the amount of serine which is glycosylated. A large increase in the hydroxyproline content of infected plants is shown, but the ratios of glycosylated serine to hydroxyproline are similar in healthy and infected plants. As far as these markers are concerned, the hydroxyproline-rich glycoproteins secreted into the wall as a result of the disease are similar to those of healthy plants. In addition, the extent of glycosylation of the wall serine, in both healthy and infected plants, decreases as the plant ages. Serine- and hydroxyproline-rich (glyco)peptides were also isolated after trypsinolysis of the wall. These (glyco)peptides include the galactosyl-containing pentapeptide, serine-hydroxyproline. This pentapeptide is characteristic of cell wall protein.

PHYSIOLOGICAL SYSTEMS

REFER ALSO TO CITATION(S) 21354, 21361

21281 (ORO—3792-21) **Developmental approach to the study of immunologic tolerance. Final report.** Hyde, R.M. (Oklahoma Univ., Oklahoma City (USA). Dept. of Microbiology and Immunology). 1978. Contract EY-76-S-05-3792. 14p. Dep. NTIS, PC A02/MF A01.

The effect of ethyl stearate and methyl palmitate on the reticuloendothelial systems (RES) of BALB/c and C57B1/6 mice has been studied. The ease of induction of immunologic tolerance to gamma globulin from different mammalian species has been studied. Several compounds have been evaluated as potential probes to ascertain the intracellular events which transpire during the induction of immune tolerance. As the cyclic nucleotides have been implicated as moderators of immune responses, it was of interest to determine the effect, if any, that agents which are known to modulate the intracellular concentration of these compounds may have on the induction of tolerance. Mitomycin C, an inhibitor of DNA replication, was studied as a possible probe to ascertain the need for cell division during tolerance induction. Actinomycin D, an inhibitor of DNA directed RNA synthesis, was next evaluated for its ability to interfere with tolerance induction. A transfer system was used to explore the metabolic requirements for tolerance induction to human gamma globulin in the murine thymocyte.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 21266, 21311

21282 **Energy-linked potassium influx as related to cell potential in corn roots.** Cheeseman, J.M.; Hanson, J.B. (Univ. of Illinois, Urbana). Contract EY-76-S-02-0790. *Plant Physiol.;* **64**: No. 5, 842-845(Nov 1979).

Cell potentials and K^+ (^{86}Rb) influx were determined for corn roots over a wide range of external K^+ activity (K^0) under control, anoxic, and uncoupled conditions. The data were analyzed using Goldman theory for the contribution of passive influx to total influx. For anoxic and uncoupled roots the K^+ influx shows the functional relationship with K^0 predicted with constant passive permeability, although K^+ permeability in uncoupled roots is about twice that of anoxic roots. In control roots the equation fails to describe K^+ infux at low K^0, but does so at high K^0, with a gradual transition over the region where the electrical potential becomes equal to the equilibrium potential for K^+ (psi = E/sub K/). In the low K^0 range, where net K^+ infux is energetically uphill, participation of an energy-linked K^+ carrier is indicated. In the high K^0 range, K^+ influx becomes passive down the electrical gradient established by the cell potential. Since the cell potential includes a substantial electrogenic component, anoxia or uncoupling reduces passive influx.

21283 **Quantitation of collateral and ischemic flows with microspheres and diffusible indicator.** Cohen, M.V. (Montefiore Hospital and Medical Center, Bronx, NY). *Am. J. Psychol.;* **234**: No. 4, H487-H495(Apr 1978).

Flow to myocardium following coronary occlusion may not originate solely from collateral channels. Some flow might be derived from overlapping coronary arteries which also perfuse tissue within the territory of the obstructed vessel prior to occlusion. Left atrial microsphere injection during perfusion of the left anterior descending (LAD) artery from a special reservoir containing microsphere-free blood and again after LAD occlusion permitted measurement of noncollateral overlap and total ischemic LAD (TIF) flows, respectively, and mathematical derivation of true collateral flow (TCF). Whereas TIF averaged 0.25 +/- 0.03 ml/min per g, TCF was 0.14 +/- 0.03 ml/min per g, only 50.6% of TIF. The remainder of the TIF represented either inadvertant myocardium or actual overlap of LAD and left circumflex circulations. 86 RbCl was injected simultaneously with the microspheres following coronary occlusion. 86 Rb and microsphere densities in the whole heart and ischemic area were closely correlated, although microsphere distribution tended to be more heterogeneous. No segment of ischemic myocardium containing 86 Rb was free of microspheres. Therefore, the geometry of undeveloped collateral channels is adequate to permit passage of 15-micron particles. Absolute 86 Rb flows were consistently less than microsphere flows.

PUBLIC HEALTH

REFER ALSO TO CITATION(S) 21359

AGRICULTURE AND FOOD TECHNOLOGY

REFER ALSO TO CITATION(S) 20319, 21189, 21225

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 21347, 21348

BIOMEDICAL SCIENCES, APPLIED STUDIES

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 21263

21284 **Are portions of the Urals really contaminated.** Stratton, W. (Los Alamos Scientific Lab., NM); Stillman, D.; Barr, S.; Agnew, H. *Science;* **206**: 423-425(26 Oct 1979).

Rumors that radiation was released by accident in the Ural Mountain area received supporting testimony from Soviet refugee and biologist Zhores Medvedev, who reported that a large area was contaminated and many persons injured. The biologist's search of Soviet open literature for clues of soil and water contamination pinpointed the affected areas on the eastern slope of the Urals at the site of early military plutonium production reactors. The nature of the contamination led him to place the source of contamination as buried radioactive waste material which exploded or erupted. The authors challenge Medvedev's interpretation and suggest the contamination resulted, instead, from the localized fallout of Soviet

atmospheric weapons tests. They cite the lack of plutonium contamination, weather and wind patterns, and the literature on atmospheric testing to support their conclusion. 10 references. (DCK)

RADIATION EFFECTS ON BIOCHEMICALS

IN VITRO

REFER ALSO TO CITATION(S) 21277

IN ANIMALS

REFER ALSO TO CITATION(S) 21297

21285 Effect of x radiation on soluble proteins of the gastric mucosa. Sukhomlinov, B.F.; Chaika, Ya.P.; Fedorovich, A.N. (Lvov State Univ., USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 3, 15-19(Dec 1979).

Translated from Radiobiologiya; 19: No. 3, 335-339(1979).

Electrophoresis in agar gel was used to separate soluble proteins of the rat gastric mucosa into 11 fractions. Proteins with proteolytic (pH 1.8) and lipase (pH 7.4) activity are localized in the second and third prealbumin fractions. Soluble proteins of the gastric mucosa contain glycoprotein and lipoprotein complexes. Exposure of rats to x radiation in a dosage of 1000 R induces quantitative redistribution of soluble proteins in the electrophoretic spectrum, as well as significant impairment of proteolytic activity of total soluble proteins throughout the observation period (10 min to 72 h).

21286 Effect of gamma radiation in the presence of serotonin on spectral properties of oxyhemoglobin solutions at different pH. Artyukhov, V.G. (Voronezh State Univ., USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 3, 26-32(Dec 1979).

Translated from Radiobiologiya; 19: No. 3, 345-350(1979).

A study was made of the nature of change in spectral properties of mouse oxyhemoglobin solutions at pH 3 to 12, when exposed to γ rays in a dosage of 6000 R in the presence of serotonin. It was established that serotonin (5.10^{-5} M) has a protective action on oxyhemoglobin solutions at pH 5 to 9. The protective effect of serotonin on protein is not manifested in the presence of catalase (1.10^{-6} M). It is stated that the process of formation of a hydrogen peroxide and serotonin complex makes a significant contribution to the protective effect of this agent on γ-irradiated oxyhemoglobin solutions.

21287 Activaton of ubiquinone biosynthesis in the liver of rats exposed to gamma radiation and given ubiquinone-9. Novoselova, E.G. (Inst. of Biological Physics, Pushchino, USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 3, 33-39(Dec 1979).

Translated from Radiobiologiya; 19: No. 3, 351-355(1979).

Determination was made of incorporation of 2-^{14}C-acetate in ubiquinone, lipid fraction and homogenate of fasting rat liver 48 h after delivery of 800 R radiation, as well as after administration of ubiquinone-9. Ubiquinone is accumulated in the liver of irradiated and nonirradiated rats; its concentration is 4 to 5 times above normal, constituting 5% of given amount of ubiquinone-9. Gamma radiation in a dosage of 800 R and a ubiquinone load induce a significant increase in rate of ubiquinone synthesis and degradation in the rat liver. It can be assumed that radiation and a load of exogenous ubiquinone affect different parts of the chain of ubiquinone biosynthesis: Exogenous ubiquinone activates the stage of ubiquinone biosynthesis that is after β-hydroxy-β-methylglutaryl-CoA reductase.

21288 Postradiation methylation of De novo synthesized DNA of rat bone marrow and thymus. Rakova, I.A. *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 3, 108-111(Dec 1979).

Translated from Radiobiologiya; 19: No. 3, 413-416(1979).

The process of methylation of newly synthesized DNA was investigated in cells of rat bone marrow and thymus after gamma irradiation. Minimum lethal radiation doses were delivered to the animals and cells were examined at 1 h and 10 days postradiation to determine the effects on transcription processes.

21289 Peroxidase activity of rat blood serum after exposure to external beta radiation and hyperthermia. Matyushichev, V.B.; Taratukhin, V.R.; Shamratova, V.G. (Leningrad State Univ., USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 3, 116-119(Dec 1979).

Translated from Radiobiologiya; 19: No. 3, 419-422(1979).

The effects of hyperthermia and beta radiation on peroxidase activity in the blood serum of rats was investigated. Dose-response relationships were established with and without hyperthermia. The significant change in radiosensitivity with hyperthermia was discussed.

RADIATION EFFECTS ON CELLS

EXTERNAL SOURCE

21290 Patterns of development of nonspecific cell reactions, and modification of chemical protection. Report 1. Correlation between development of nonspecific cell reaction and conditions under which cysteamine and caffeine benzoate are used, and explanation thereof. Veksler, A.M.; Korystov, Yu.N.; Kublik, L.N.; Eidus, L.Kh. (Inst. of Biological Physics, Pushchino, USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 3, 40-46(Dec 1979).

Translated from Radiobiologiya; 19: No. 3, 356-362(1979).

A study was made of patterns of development of the nonspecific reaction of cells to various agents referable to the category of weak electrolytes. It was shown that the rate of development of the nonspecific reaction to cysteamine and caffeine benzoate depends on the concentration of the substance, temperature, and medium pH. It was established that the cell's reaction is not determined by the specifics of each agent, but by its total concentration within the cell, which depends on the physicochemical properties of the agent, and it may differ substantially from its concentration in the medium in the presence of a pH gradient between the cell and medium. Both agents were found to be virtually equally effective when present in the same intracellular concentration. The hypothesis is expounded that the efficacy of a number of other biologically active substances, many of which are weak electrolytes, can be assessed on this basis.

21291 Radiosensitivity of colony-forming stromal cells isolated from the spleen of a patient with lymphogranuloma and exposed to fast neutrons. Konoplyannikov, A.G.; Rudakova, S.F.; Abdulbarova, S.Sh. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 3, 120-123(Dec 1979).

Translated from Radiobiologiya; 19: No. 3, 422-425(1979).

The effects of fast neutrons on cell cultures of spleen cells from a patient with Hodgkin's disease was investigated. The survival of CFU as a function of dose was measured. The radiosensitivity of these cells was compared to spleen cells from guinea pigs and was found to be 2 to 3 times more resistant than the latter.

21292 Comparison of two nitroimidazoles and a dihydroquinoline as radiosensitizers and cytotoxic agents. Hall, E.J. (Columbia Univ., NY); Astor, M.; Osmak, R.; Shapiro, P.; August, L. Contract EP-78-S-02-4733. *Int. J. Radiat. Oncol., Biol. Phys.;* **5**: No. 10, 1781-1786(Oct 1979).

From 20. annual scientific meeting of the American Society of Therapeutic Radiologists; Los Angeles, CA, USA (2 Nov 1979).

The search for electron affinic compounds that exhibit the properties needed for a clinically useful hypoxic cell radiosensitizer has led to the setting up of clinical trials with misonidazole, which is a 2-nitroimidazole. Recently, MTDQ a new drug of novel design, a dihydroquinoline (6,6-methylene-bis-2,2,4-trimethyl-1,2-dihydroquinoline) has been synthesized and suggested as a radiosensitizer. The radiosensitizing and cytotoxic properties of misonidazole are compared with MTDQ and a second 2-nitroimadazole Ro-07-0741, which has warranted attention as a possible alternative to misonidazole for clinical use.

BASIC STUDIES

REFER ALSO TO CITATION(S) 20188

RADIATION EFFECTS ON PLANTS

BASIC STUDIES

REFER ALSO TO CITATION(S) 20188

21293 Effect of dissymmetry of corn seeds on yield of gamma-induced free radicals as a function of dosage. Krasnobaev, E.N.; Maslobrod, S.N. (Moldavian Academy of Sciences, Kishinev, USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 3, 158-162(Dec 1979).

Translated from Radiobiologiya; 19: No. 3, 451-455(1979).

The concentration of free radicals in dissymetric corn seeds following gamma radiation was investigated. The optimum dose rates for presowing for symmetrical and dissymmetrical seeds were discussed.

RADIATION EFFECTS ON ANIMALS

MAN

REFER ALSO TO CITATION(S) 20202, 21273, 21296

21294 (DOE/TIC—11176) **Health effects of low level radiation.** Auxier, J.A. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 13p. Dep. NTIS, PC A02/MF A01.

A short review of the health effects of low level of radiation is presented. Emphasis is placed on effects on bone marrow and incidence of leukemia. Dose-response curves are presented. (ACR)

21295 (PB—80-101124) **A computer code for Cohort Analysis of Increased Risks of Death (CAIRD). Technical report.** Cook, J.R.; Bunger, B.M.; Barrick, M.K. (Office of Radiation Programs, Washington, DC (USA). Div. of Criteria and Standards). Jun 1978. 119p. NTIS, PC A06/MF A01.

The most serious health risk confronting individuals exposed to radiation is death from an induced cancer. Since cancers usually do no develop until many years after exposure, other causes of death may intervene and take the lives of those destined to die from cancer. This computer code has been developed to aid risk analysis by calculating the number of premature deaths and loss of years of life produced by a hypothetical population after exposure to a given risk situation. The code generates modified life tables and estimates the impact of increased risk through several numerical comparisons with the appropriate reference life tables. One of the code's frequent applications is in estimating the number of radiation induced deaths that would result from exposing an initial population of 100,000 individuals to an annual radiation dose. For each risk situation analyzed, the computer code generates a summary table which documents the input, data and contains the results of the comparisons with reference life tables.

VERTEBRATES

REFER ALSO TO CITATION(S) 20188, 21247, 21285, 21287, 21288, 21289, 21292, 21322

21296 (PB—80-102940) **CSU-FDA collaborative radiological health laboratory annual report 1978.** Benjamin, S.A. (Collaborative Radiological Health Animal Research Lab., Fort Collins, CO (USA)). Aug 1979. Contracts FDA-72-302;FDA-223-76-6002. 150p. NTIS, PC A07/MF A01.

The Division of Biological Effects of the Bureau of Radiological Health, Food and Drug Administration, plans, conducts, and supports experimental and epidemiologic research on the biological effects of exposure to ionizing and nonionizing radiation. Through intramural and extramural epidemiologic studies and laboratory investigations, and critical reviews of the literature, the division studies and evaluates possible health effects resulting from exposure to radiation. Of particular interest are effects of the low radiation doses to which large segments of the population may be exposed. The Collaborative Radiological Health Laboratory was conceived in 1962 as a joint undertaking between the Division of Biological Effects, BRH, and the Department of Radiology and Radiation Biology at Colorado State University. The Laboratory's primary responsibility is to conduct a long-term study of the mortality, morbidity, and physiopathology of beagles exposed to a single low dose of ionizing radiation in utero or early in life. The results of this study will provide insight into the lifetime risks associated with pre- and postnatal exposure to low levels of ionizing radiation. The research program has been separated into three segments. The major study (Segment III) involving 1,680 beagles was initiated in December 1967. Supportive studies (Segments I and II) designed to provide basic information necessary for evaluating delayed effects were initiated in 1964.

21297 **Nucleic acid metabolism in the rat thymus at the long term after prolonged exposure to divided doses of radiation.** Kisel'gof, E.I. *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 3, 9-14(Dec 1979).

Translated from Radiobiologiya; 19: No. 3, 330-334(1979).

A study was made of nucleic acid metabolism in the rat thymus for 1 year after discontinuing long-term delivery of radiation in cumulative doses of 1000 and 2000 R. A correlation was demonstrated between restoration of indices of nucleic acid metabolism, number of thymocytes and weight of thymus, on the one hand, and cumulative dose delivered, on the other.

21298 **Restoration of hemopoiesis in mice after long-term delivery of divided doses of radiation.** Muksinova, K.N. *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 3, 20-25(Dec 1979).

Translated from Radiobiologiya; 19: No. 3, 340-344(1979).

It was demonstrated that there is a dissimilar extent of restoration of number of cellular elements in CFU [colony-forming units] and morphologically identifiable bone marrow precursors, as well as peripheral blood of BALB/c mice after long-term exposure to radiation at the rate of 50 R/day. A correlation was demonstrated between the rate and nature of recovery of CFU, on the one hand, and cumulative radiation dose, on the other. Along with reduction of the CFU population at the late postradiation term, a stable increase in percentage of such cellular elements at the S stage of the cycle was observed.

21299 **Biochemical distinctions of regenerative muscle possibly related to increased radioresistance thereof.** Van Caneghem, P.; Popova, M.F. (Univ. of Liege, Belgium). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 3, 47-52(Dec 1979).

Translated from Radiobiologiya; 19: No. 3, 363-367(1979).

A comparative investigation was made of the levels of certain endogenous radioprotective agents in normal, as well as regenerative muscle following severe mechanical trauma or denervation, for the purpose of further study of the nature of enhanced radioresistance of actively regenerating tissues. It was established that nonprotein SH group content and activity of glutathione peroxidase and superoxide dismutase are considerably higher in muscles that are in a regenerating protective-restorative state.

21300 **Role of endogenous substances in enhancing radioresistance background. Report 12. Possible role of mast cells in enhancing radioresistance background in rats.** Goncharenko, E.N.; Gorskaya, T.G.; Graevskaya, E.E.; Kozlova, M.A. (Moscow State Univ., USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 3, 53-57(Dec 1979).

Translated from Radiobiologiya; 19: No. 3, 368-371(1979).

This study deals with the possible sources of accumulation of endogneous amines in radiosensitive tissues with administration of radioprotective agents. The obtained data support the assumption that mast cells, with their large reserve of biogenous amines, may be one of the resources involved in mobilizing endogenous defense resources of an organism treated with radioprotective agents.

21301 **Effect of some pharmacological agents on radioprotective activity, toxicity and distribution of ^{35}S-amino propyl aminoethyl thiophosphate administered by mouth.** Grechka, I.I.; Belavina, L.P.; Kalistratov, G.V.; Zherebchenko, P.G. *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 3, 58-63(Dec 1979).

Translated from Radiobiologiya; 19: No. 3, 372-376(1979).

The influence of adrenolytics, cholinolytics and a cholinomimetic on radioprotective efficacy, toxicity and distinctions of distribution of APAETP in organs after intake by mouth and intraperitoneal injection was studied in experiments on mice. Atropine and INPEA attenuated the toxicity of APAETP and its radioprotective efficacy when given by mouth and did not affect these properties when it was administered intraperitoneally. One could also assess the capacity of atropine and INPEA to intensify retention of APAETP in the stomach according to accumulation of labeled APAETP in organs after intake by mouth.

21302 **Effect of thiourea dioxide on toxicity and radioprotective activity of sulfur-containing radioprotective agents.** Zherebchenko, P.G.; Terekhov, A.V.; Belavina, L.P.; Besedina, L.N.; Znamenskii, V.V.; Kalistratov, G.V. *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 3, 64-68(Dec 1979).

Translated from Radiobiologiya; 19: No. 3, 377-380(1979).

In this work it was demonstrated that thiourea dioxide can lower the toxicity of a number of sulfur-containing radioprotective agents. Along with lowering the toxicity of the products studied, attenuation of their radioprotective efficacy is noted when they are combined with thiourea dioxide. The obtained data are quite consistent with the fact that thiourea dioxide alters distribution of ^{35}S-cystaphos in mouse organs, causing a drastic decrease in accretion of the tracer in the brain and spleen with concurrent increase in the kidneys.

21303 **Significance of parameters of functional activity of the adrenohypophyseal system to evaluation of individual radiosensitivity.** Korotkevich, A.O. *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 3, 69-73(Dec 1979).

Translated from Radiobiologiya; 19: No. 3, 381-384(1979).

Experiments were conducted on male Wistar rats weighing 269 +- 10 g. Individual radiosensitivity, severity and outcome of radiation sickness were compared to base parameters of activity of the adrenohypophyseal system, leukocyte count and individual weight gain, and changes therein 3 h after delivery of radiation in a dosage of 850 R. The rats were divided into three groups, according to the obtained indices: hyporeactive, normoreactive and hyperreactive. It was demonstrated that rat mortality as a function of level of activity of the adrenohypophyseal system is V-shaped, with the lowest mortality in the normoreactive group.

21304 **Therapeutic effect of DNA preparations varying in molecular mass on irradiated rats.** Mushkacheva, G.S.; Turdakova, V.A.; Rusina, T.N.; Luzanova, O.V.; Rogacheva, S.A. *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 3, 74-78(Dec 1979).

Translated from Radiobiologiya; 19: No. 3, 385-388(1979).

Studies were made of the therapeutic effect of rat thymus and spleen DNA as a function of its polymerization in experiments on Wistar rats exposed to radiation in doses of 750, 820, 840 and 875 R. Base preparations with a mean molecular mass of 34.10^6 dalton, mechanically degraded to $14.5.10^6$, $9.2.10^6$, $5.8.10^6$, dalton and, by means of ultrasound, to $0.9.10^6$ dalton were used. Preparations with average polymerism, with molecular mass of $5.5.10^6$ to 13.10^6 dalton,

had a marked therapeutic effect, increasing survival of irradiated animals by 15 to 25%, as compared to the irradiated control.

21305 Remigration of mouse bone marrow stem cells. Gronskaya, N.F.; Strelin, G.S. (Central Scientific Research Inst. of Roentgenology and Radiology, Leningrad, USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 3, 79-84(Dec 1979).

Translated from Radiobiologiya; 19: No. 3, 389-393(1979).

It was demonstrated on mice that bone marrow stem cells migrate to the irradiated (2000 R) region of bone marrow, then migrate again (remigrate) to the rest of the body after irradiation thereof, with shielding of previously irradiated regions, repopulating hemopoietic organs. The data on survival of animals, cellularity of bone marrow, weight of the spleen and endogenous colony formation in it are indicative of remigration. The effectiveness of remigration depends on the size of the initially irrated bone marrow region shielded for the second irradiation, as well as interval between irradiations Remigration is manifested by a decrease in number of myelokaryocytes in the region from which it occurs, in accordance with repopulation of the rest of the bone marrow.

21306 RBE of neutron radiation with damage to the canine hemopoietic system. Glazkov, V.I.; Gozenbuk, V.L.; Keirim-Markus, I.B. (Inst. of Biophysics, Moscow, USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 3, 85-89(Dec 1979).

Translated from Radiobiologiya; 19: No. 3, 394-397(1979).

Overall coefficients for quality of neutron radiation were determined for a two-component dose-activity of bone marrow hemopoiesis function. It was established that these coefficients depend on the mean LET of neutrons with different energy spectra.

21307 Radiobiology of stem cells of the intestinal epithelium. Report 3. Effect of delivery of divided doses of radiation on mice of two age groups. Konoplyannikova, O.A.; Konoplyannikov, A.G. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 3, 90-93(Dec 1979).

Translated from Radiobiologiya; 19: No. 3, 398-401(1979).

The method of delivery of divided doses of radiation was used to demonstrate that stem cells of the intestinal epithelium of mice 18 months of age repair sublethal radiation lesions more slowly than in mice that are 3 months old.

21308 Effects of radioprotective agents referable to different classes of chemical compounds on DNA synthesis in radiosensitive tissues. Chigareva, N.G. *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 3, 112-115(Dec 1979).

Translated from Radiobiologiya; 19: No. 3, 416-419(1979).

The effects of cystamine, S(ω-aminopropyl)-β-aminoethyl thiophosphate (APAETP) and some derivatives of benzo-2,1,3-thiadiazole on DNA synthesis in the spleen and intestinal mucosa of the mouse was investigated. A correlation between radioprotective agents and depression of DNA synthesis was discussed.

21309 Mechanism of therapeutic effect of α_2-macroglobulin on the irradiated hemopoietic system. Simonova, L.I.; Shantyr, V.I. (Khar'kov Scientific Research Inst. of Medical Radiology, USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 3, 124-128(Dec 1979).

Translated from Radiobiologiya; 19: No. 3, 425-429(1979).

The mechanism of the action of macroglobulin in response to x irradiation of the hemopoietic system of rats was investigated. The synthesis of nucleic acids and total protein were determined at various stages of radiation sickness. Marked depression of protein and nucleic acid biosynthesis in the hemopoietic organs was found. Administration of macroglobulin led to normalization of DNA and RNA synthesis in bone marrow and lymphoid organs.

21310 Radioprotective effect of endotoxins as a function of molecular weight and chemical compositions. Vasil'eva, T.G.; Pavlova, L.M.; Shapiro, N.I.; Sverdlov, A.G.; Kolotinskaya, T.M. (Scientific Research Inst. of Vaccines and Sera, Leningrad, USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 3, 129-133(Dec 1979).

Translated from Radiobiologiya; 19: No. 3, 429-433(1979).

The radioprotective properties of S. paratyphi B. endotoxin and fractions from it were investigated. The molecular weights and chemical composition were determined. Fractions of both high and low molecular weights were isolated and the radioprotective action of both were tested in mice.

21311 Effect of hemodynamic changes on postradiation functional state of the rat small intestine. Nesterenko, V.S.; Piskarev, A.V.; Sushkevich, L.N. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 3, 134-137(Dec 1979).

Translated from Radiobiologiya; 19: No. 3, 433-436(1979).

The effect of total body irradiation on blood flow in the intestinal wall and the functional state of the mucosa in rats were investigated. Correlation between changes in postradiation blood flow and intestinal absorption of glucose, albumin, thyroxine, and fatty acids were discussed.

21312 Role of lipid pigments in processes of radiation damage and protection. Vertushkov, V.T. (Dnepropetrovsk State Experimental Stock-Breeding Station, USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 3, 138-141(Dec 1979).

Translated from Radiobiologiya; 19: No. 3, 436-439(1979).

The radioprotective mechanism of cystamine in mice was investigated. The relationship between the appearance of lipopolymers in the blood and organs of the animal after injection of cystamine was discussed. The radioprotective action of lipopolymers injected in mice was demonstrated. The accumulation of lipopigments containing products of oxidative polymerization of lipids following ionizing radiation and radiation injury was also discussed.

21313 Influence of numerous injections of saline on survival of mice exposed to radiation under different conditions. Airapetyan, G.M. (Scientific Research Inst. of Biological Testing of Chemical Compounds, Kupavna, USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 3, 142-144(Dec 1979).

Translated from Radiobiologiya; 19: No. 3, 439-441(1979).

The use of saline in the treatment of radiation injury was discussed. Following whole-body irradiation of mice, saline was injected numerous times into the peritoneum and its therapeutic effect was discussed.

21314 Use of APAETP for the prevention of endogenous infection in irradiated rats. Mal'tsev, V.N.; Strel'nikov, V.A.; Znamenskii, V.V.; Terekhov, A.V. *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 3, 145-148(Dec 1979).

Translated from Radiobiologiya; 19: No. 3, 442-444(1979).

The use of aminopropyl aminoethyl thiophosphoric acid to reduce post irradiation bacterial infections in rats was investigated. It was demonstrated that radioprotective agents which attenuate the severity of radiation sickness also attenuate endogenous infection in the irradiated organism.

21315 RBE coefficient as an indicator of irradiation of large animals. Glazkov, V.I.; Gozenbuk, V.L.; Keirim-Markus, I.B. (Inst. of Biophysics, Moscow, USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 3, 149-152(Dec 1979).

Translated from Radiobiologiya; 19: No. 3, 445-448(1979).

The use of the RBE coefficient as a description of radiation effects in animals is evaluated. Methods for determining RBE coefficients to gamma and neutron radiation are presented. Problems in the extrapolation of RBE values from RBE coefficients are discussed.

21316 Mechanism of enhancement of response to radiation therapy of tumors treated with dihydromonocalcium phosphate. Yakovleva, S.S.; Efimov, M.L.; Shafranskii, L.L. (Kazakh Scientific Research Inst. of Oncology and Radiology, Alma-Ata, USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 3, 153-157(Dec 1979).

Translated from Radiobiologiya; 19: No. 3, 448-451(1979).

Histochemical studies of calcium salt content and phosphatase activity in tumors were performed to determine the enhancement mechanisms of dihydromonocalcium phosphate and x irradiation in the treatment of neoplasms in rats.

21317 Radioprotective efficacy of tilorone. Chertkov, K.S.; Talosh, M.; Mosina, Z.M.; Preobrazhenskii, Yu.Yu. *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 3, 163-166(Dec 1979).

Translated from Radiobiologiya; 19: No. 3, 455-458(1979).

The radioprotective effects of tilorone on survival of irradiated mice were studied. Survival as a function of route of administration, time, and dose of tilorone administered prior to irradiation was discussed.

21318 Genetically uniform strains of fish as laboratory models for experimental studies of the effects of ionizing radiation. Woodhead, A.D.; Setlow, R.B. (Brookhaven National Lab., Upton, NY (USA)); Hart, R.W. (Ohio State Univ., Columbus (USA). Dept. of Radiology). pp 317-333 of Methodology for assessing impacts of radioactivity on aquatic ecosystems. Vienna, Austria; International Atomic Energy Authority (1979).

The advantages are discussed of using a genetically uniform test animal such as the amazon molly, Poecilia formosa, to reduce the biotic variability in experimental determination of the effects of ionizing radiation on aquatic ecosystems. Besides a cost reduction from using less organisms for these radiation-effect studies, another significant advantage of the higher precision responses due to homozygous genetic material is the assessment of radiation effects at the molecular and cellular levels.

INVERTEBRATES

REFER ALSO TO CITATION(S) 20188

RADIONUCLIDE EFFECTS - INTERNAL SOURCE

MAN

REFER ALSO TO CITATION(S) 21173, 21324, 21450

ANIMALS

REFER ALSO TO CITATION(S) 21328

21319 Nucleic acid metabolism in radiosensitive rat tissues at the short and long term after intake of tritium oxide. Shorokhova, V.B.; Revina, V.S.; Turdakova, V.A.; Mushkacheva, G.S. *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 3, 1-8(Dec 1979).

Translated from Radiobiologiya; 19: No. 3, 323-329(1979).

Administration of tritium oxide (0.6 mCi/g weight) to rats shortened life span and increased the incidence of tumors. It was also demonstrated that there is a reduction in mass of bone marrow, spleen and thymus, decrease in nucleic acid content, increase in RNA and DNA biosynthesis, and activation of DNAases at the acute stage of damage. During the period of formation of long-term effects, there was another decrease in concentration of nucleic acids and depression of rate of biosynthesis thereof.

21320 Radioprotective effect of calcium given with feed on exposure to tritium oxide. Kazbekova, D.A.; Kalistratova, V.S.; Kulyamin, V.A. *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 3, 94-101(Dec 1979).

Translated from Radiobiologiya; 19: No. 3, 402-407(1979).

A 1.5-fold increase in calcium content of the rat diet attenuates the symptoms of radiation sickness induced by tritium and prolongs survival time. Elevation of blood serum nonspecific cholinesterase level and stimulation of lymphopoiesis were observed. The possible mechanisms of radioprotective action of calcium are discussed.

21321 Toxicity of tritiated thymidine. Zhuravlev, V.F.; Kalyazina, N.S. *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 3, 167-170(Dec 1979).

Translated from Radiobiologiya; 19: No. 3, 458-462(1979).

The toxicity of tritiated thymidine in mice was compared with comparable doses of tritium oxide and non-radioactive thymidine. The general condition of the animal, peripheral blood, survival time, and LD/50/30 following intraperitoneal administrations of the compounds were discussed.

21322 Radiation damage and repair of lung tissues after intratracheal administration of cerium-144 combined with total-body external radiation. Lavrent'ev, L.N. (Scientific Research Inst. of Radiation Hygiene, Leningrad, USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 3, 177-181(Dec 1979).

Translated from Radiobiologiya; 19: No. 3, 467-471(1979).

The recovery processes and radiation pathology in the lungs of rats following intratracheal administration of cerium-144 and whole-body irradiation were studied. The rate of elimination of the radionuclide was monitored. Pathological changes in the trachea and lungs were discussed.

NUCLIDE KINETICS AND TOXICOLOGY

REFER ALSO TO CITATION(S) 21188

MAN

REFER ALSO TO CITATION(S) 21173, 21268

21323 (CONF-791077—5) URN model approach to actinide metabolism. Bernard, S.R. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 17p. Dep. NTIS, PC A02/MF A01.

From Workshop on measurement and interpretation of actinide accumulation by man; Snowbird, UT, USA (14 Oct 1979).

A model describing the metabolism of plutonium with appropriate compartments, residence times, and transfer coefficients sufficient for radiation protection purposes is presented. The model used is the classical mammillary urn model of Sheppard and Householder (1951). (ACR)

21324 (PB—80-101983) Plutonium Air Inhalation Dose (PAID): a code for calculating organ doses due to the inhalation and ingestion of radioactive aerosols. Technical memo. Sullivan, R.E. (Office of Radiation Programs, Washington, DC (USA). Div. of Criteria and Standards). Jun 1977. 50p. NTIS, PC A03/MF A01.

The technical note describes a computer code, PAID developed to determine time dependent dose rates and doses from inhaled or ingested radionuclides. The main purpose of this code is to determine the dose rates and doses caused by the intake of transuranic nuclides and their decay products. The two primary modes leading to internal radiation exposure are the inhalation and ingestion of radioactive materials. The estimation of organ burden and exposure, as well as of the resulting dose rates and doses, due to uptake by these pathways is relatively complicated and requires the adoption of mathematical models which depend on many parameters. A computer code which implements the lung model described by the ICRP Task Group on Lung Dynamics is presented below. This model has been augmented to also include the dose due to the transfer of radioactivity to other organs from ingested materials.

21325 Gallium: mechanisms. Hoffer, P. (Yale Univ. Medical School, New Haven, CT). *J. Nucl. Med.;* **21**: No. 3, 282-285(Mar 1980).

The mechanisms of ^{67}Ga localization in the body are discussed. Included in the discussion are: general biological considerations; specific mechanisms of uptake; and mechanisms of localization in tumors. (ERB)

21326 Bone tumors in Thorotrast patients. Mays, C.W. (Univ. of Utah, Salt Lake City); Spiess, H. Contract EY-76-C-02-0119. *Environ. Res.;* **18**: No. 1, 88-93(Feb 1979).

Among the Thorotrast patients throughout the world, nine bone sarcomas (six histologically confirmed and three possible) were reported as of 1974. Their appearance times ranged from 16 to 33 years, averaging 26 years after Thorotrast injection. In some countries the population at risk is uncertain, but in Denmark, Germany, and Portugal, about 3000 patients have been followed more than 10 years (45,000 persons - years at risk beyond the first 10 years). In these 3000 patients, three to six bone sarcomas have occurred, compared with 0.5 case expected naturally. Using the dosimetric results of Rowland and Rundo and assuming the translocating ^{224}Ra was mainly responsible, the provisional risk coefficient is 55 to 120 bone sarcomas/10^6 person - rad of actual dose to the skeleton without marrow. This risk coefficient is highly tentative because it is based on only three to six bone sarcomas, all reported since 1972. If additional bone sarcomas occur among the living Thorotrast patients, the risk coefficient could increase appreciably. For comparison, the risk coefficient for long protracted injections of ^{224}Ra is about 200 bone sarcomas/10^6 person - rad, based on 54 cases of bone sarcoma.

21327 Study of radioactivity and health status of former thorium workers. Rundo, J.; Polednak, A.P.; Brues, A.M.; Lucas, H.F. Jr.; Patten, B.C.; Rowland, R.E.; Stehney, A.F. (Argonne National Lab., IL). *Environ. Res.;* **18**: No. 1, 94-100(Feb 1979).

Studies have been started of the late effects of thorium on the health of a population of 4316 persons (80% males) who worked at a thorium refinery during the period from the mid-1930s to 1973. The population and the study are described briefly, as are the methods and results to date of measurements of radioactivity in vivo and in the exhaled breath. Of 46 men examined so far, all but three had readily measurable amounts of thoron in the breath, but there was little correlation between the amount of activity in the breath and the ^{212}Bi content of the chest.

ANIMALS

REFER ALSO TO CITATION(S) 21268, 21271

21328 (AD-A—071655) A system for exposure of rats and mice to aerosols of plutonium oxide. Design and construction of an exposure suite for mice. Walsh, M.; Black, A.; Moores, S.R.; Pritchard, J. (UKAEA Atomic Energy Research Establishment, Harwell). Feb 1979. 24p. NTIS PC A02/MF A01.

Studies are being made to investigate the early and late pathological effects of plutonium oxide deposited in the rodent lung and their dependence on particle size and dose. The primary design consideration was the safety of personnel involved in the experiments and consequently all operations associated with animal exposures are carried out in glove boxes under carefully controlled conditions. This has placed restraints upon the manner in which these operations are performed. Thus, equipment has been designed to operate under these conditions and to minimise the possibility of an accidental exposure to plutonium oxide.

21329 Tellurium-123m-labeled 23-(isopropyl telluro)-24-nor-5α-cholan-3β-ol: a new potential adrenal imaging agent. Knapp, F.F. Jr.; Ambrose, K.R.; Callahan, A.P. (Oak Ridge National Lab., TN). *J. Nucl. Med.;* **23**: No. 3, 251-257(Mar 1980).

Tellurium-123m-labeled 23-(isopropyl telluro)-24-nor-5α-cholan-3β-ol (24-telluracholestanol, or 23-ITC) has been prepared as a potential adrenal-imaging agent. The new agent was synthesized by the coupling of 3β-acetoxy-23-bromo-24-nor-5α-cholan with Te-123m-labeled sodium isopropyl tellurol. Tissue distribution experiments in both male and female rats indicate a high adrenal concentration of radioactivity following administration of this agent. In female rats the adrenal glands accumulated 4.5% of the injected

radioactivity only 1 day after administration of Te-123m-23-ITC. The adrenal-to-liver ratio was 42 after 1 day, and this increased to 100 after 3 days. Chromatographic analyses of lipid extracts from adrenal, ovary, liver, and lungs suggest that this agent is metabolized by these tissues. Examination of the rats' excretory products has indicated that approximately 50% of the administered radioactivity is excreted in the feces with 5 days after injection of Te-123m-23-ITC. Moreover, the adrenals and ovaries of rats have been clearly imaged with this agent, both with a rectilinear scanner and with an RC type of proportional-counter camera.

21330 Kinetics of plutonium-239 metabolism and doses in dog tissues after inhalation of the radionuclide in polymer form. Buldakov, L.A.; Kalmykova, Z.I. *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 3, 102-107(Dec 1979).

Translated from Radiobiologiya; 19: No. 3, 408-412(1979).

Clearance of plutonium-239 from the lungs is unrelated to the administered amount after dogs inhale polymer plutonium 239 in doses of 0.1 to 10 μ Ci/kg, and it occurs within 2100 days with a half-life for elimination of 555 days. In most internal organs, maximum plutonium content is reached by the 300th to 2100th day. After reaching a maximum, there is a decline of plutonium activity in organs, with half-life for elimination of 555 to 2200 days. Daily excretion of plutonium constitutes 0.035 to 0.15% of the level in the lungs on the day of the experiment in feces and 0.021 to 0.25% in urine. The magnitude of daily excretion of the radionuclide in urine constitutes 8% of its level in blood. There is no correlation between plutonium content of the skeleton, liver and excreta.

21331 Postinhalation kinetics of metabolism of americium-241 and absorbed doses in organs. Buldakov, L.A.; Kalmykova, Z.I. *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 3, 171-176(Dec 1979).

Translated from Radiobiologiya; 19: No. 3, 462-467(1979).

The metabolism of soluble americium-241 compounds administered to dogs by inhalation was studied over a period of 6.5 years. The rate of excretion of americium-241 in feces and urine, organ uptake, and survival were monitored.

PLANTS

REFER ALSO TO CITATION(S) 21187, 21220

THERMAL EFFECTS

MICROORGANISMS

REFER ALSO TO CITATION(S) 21223

VERTEBRATES

21332 (ANL—78-65(Pt.3), pp 29-32) **Field laboratory for in situ contaminant studies with fish.** Romberg, G.P.; Prepejchal, W.; Thommes, M.M. 1978.

In Radiological and Environmental Research Division: ecology. Annual report, January-December 1978.

A mobile field laboratory outfitted for studying the effects of thermal plume residence on the uptake of pollutants by Lake Michigan fish is described. Experiments are being conducted with the broth trout, because of this important species exhibits extended plume residence. Schematic diagrams of the laboratory and its various components are included. (JGB)

21333 (ANL—78-65(Pt.3), pp 33-36) **Temperature selection by brown trout residing in a thermal discharge area.** Spigarelli, S.A.; Thommes, M.M. 1978.

In Radiological and Environmental Research Division: ecology. Annual report, January-December 1978.

Brown troug (Salmo trutta) are common occupants of thermal discharge areas and are frequently caught by sport fishermen at shoreline discharge sites on Lake Michigan. Since 1972, three independent methods have been developed and used to estimate temperature selection by fish occupying heated discharges: a temperature-integrating fish tag; measurement of fish body temperatures immediately after capture from a thermal plume; and underwater telemetric monitoring of fish responses to plume temperatures. The results obtained by each method are summarized and compared. Temperature-integrating fish tags were placed on 376 brown trout collected at the Point Beach Nuclear Power Plant between 1973 and 1974, and 20 recaptured tags were analyzed to determine mean exposure temperatures for each fish. Body temperatures of 339 brown trout were measured immediately after their capture from the thermal discharge area at Point Beach between August 1972 and October 1973. Occupied water temperatures and internal body temperatures of 44 plume-resident brown trout were monitored using radiotelemetry between October 1975 and October 1977. Results indicated that brown trout select intermediate plume temperatures during each season and only select their final preferred temperature (17 to 18°C) in summer when maximum ambient temperatures occur. However, the seasonal selected temperatures (mean or mode) consistently exceed mean intake (T/sub i/) temperatures by 3 to 10°C, indicating elevated acclimation by plume-resident fish. Maximum increases in body temperature (T/sub b/ to T/sub i/) occur during seasons with low ambient temperatures, i.e., behaviorally-controlled increases in body temperature are inversely related to natural water temperatures.

21334 (ANL—78-65(Pt.3), pp 37-43) **Organic contaminants in thermal plume resident brown trout.** Romberg, G.P.; Bourne, S. 1978.

In Radiological and Environmental Research Division: ecology. Annual report, January-December 1978.

A pilot study was conducted to identify possible contaminants accumulated by thermal plume-resident fish in Lake Michigan. Brown trout were maintained in tanks receiving intake and discharge ($\leq$ 21°C) water from a power plant and were fed a diet of frozen alewife. Fish were sampled over a period of 127 days in order to estimate uptake rates and equilibrium levels for toxic organic and inorganic materials occurring in Lake Michigan fish and water. Experimental fish and natural samples were analyzed to determine the distribution of contaminants in various tissues and the corresponding pollutant levels in similar size brown trout from Lake Michigan. The quantitative analyses for the major organic contaminants are summarized. Without exception, the pyloric caecum of brown trout contained the highest concentration of lipids, PCB's, and chlorinated pesticides. Gill and kidney samples contained lower concentrations of contaminants than the caecum, while liver and muscle values were lowest.

21335 (CONF-800348—1) **Environmental quality for striped bass.** Coutant, C.C. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7403-ENG-26. 26p. Dep. NTIS, PC A03/MF A01.

From 5. marine recreational fisheries symposium; Savannah, GA, USA (26 Mar 1980).

Effects of environmental changes on the quality of life for striped bass populations can be evaluated objectively with modern procedures of environmental risk analysis. Such analysis requires knowledge of the sources of risk in the context of environmental requirements of the species. A prime environmental requirement of striped bass appears to be a suitable thermal structure that accommodates the hereditary thermal niche, which changes with age. Strong thermal preferences had promoted striped bass survival in the pristine natural estuaries of eastern North America, but they may increase risks to the species in some new environments and in native ones that are altered by man. The magnitude and likelihood of risks for striped bass from many pollutants and physical changes (structures or water flow, for example) depend upon the fish's thermally controlled distribution. The importance of a species' thermal niche and of the thermal structure of aquatic environments for population success is only beginning to be recognized and included in risk assessments.

CHEMICALS METABOLISM AND TOXICITY

REFER ALSO TO CITATION(S) 20089, 20318, 21135, 21263

CELLS

REFER ALSO TO CITATION(S) 21268

21336 Simultaneous preparation of nuclear DNA, RNA, and protein from carcinogen treated-hamster embryo fibroblasts. MacLeod, M.C.; Mansfield, B.K.; Huff, A.; Selkirk, J.K. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Anal. Biochem.;* **97**: No. 2, 410-417(1 Sep 1979).

Nuclei from hamster embryo fibroblasts treated with radioactive benzo(a)pyrene were lysed in 6 M guanidine, and nuclear macromolecules were separated by isopycnic centrifugation in Cs_2SO_4. Control experiments showed that cross-contamination of the RNA, DNA, and protein fractions was less than 2% of the total recovery of each macromolecular class. When compared to previous techniques utilizing phenol extraction, similar specific activities of bound hydrocarbon (pmol benzo[a]pyrene/mg protein or nucleic acid) were obtained. However, overall recoveries of macromolecular components were higher with the present method. In addition, recovery of undegraded histones in the density gradient preparation of nuclear protein was demonstrated by sodium dodecyl sulfate-polyacrylamide gel electrophoresis, and recovery of native DNA was demonstrated by thermal denaturation studies. Although developed specifically for work with carcinogenic hydrocarbons, the Cs_2SO_4 technique should be generally useful in cases where it is necessary to prepare all three classes of macromolecules from one batch of nuclei.

MICROORGANISMS

21337 (DOE/EV/04477—1) **Paramecium tetraurelia: prescreen for hazardous agents.** Smith-Sonneborn, J.; Herr, C.; VanKirk, E. (Wyoming Univ., Laramie (USA)). 1979. Contract AC02-77EV04477. 37p. Dep. NTIS, PC A03/MF A01.

The ciliated protozoan, paramecia, is proposed as a eukaryote model system for use in short-term screening assays for detection of mutagenic/carcinogenic and hazardous agents. The approach utilizes two assays: the mutagenic and photodynamic systems.

PLANTS

REFER ALSO TO CITATION(S) 21183, 21199, 21200

21338 (ANL—78-65(Pt.3), pp 1-4) **Effects of chronic sulfur dioxide fumigation on development, yield, and seed quality of field-grown soybeans: summary of 1977 and 1978 experiments.** Sprugel, D.G.; Miller, J.E.; Xerikos, P.B.; Smith, H.J. 1978.

In Radiological and Environmental Research Division: ecology. Annual report, January-December 1978.

Research progress is reported in the soybean-SO_2 study to determine the effect of sulfur dioxide fumigation on soybean yield at harvest, under field conditions. Significant yield reductions occurred at all fumigation levels used in 1977 and 1978, including three plots where the SO_2 concentration during the fumigations was about 100 ppB (260 $\mu g/m^3$). These levels are considerably lower than those which have previously been thought to cause damage to soybeans. As in 1977, yield reductions occurred in 1978 even where no visible damage occurred, and under conditions which did not violate US Environmental Protection Agency Secondary Air Quality Standards for sulfur oxides. To provide detailed data on the effect of SO_2 fumigation on soybeans, individual plants from each fumigated and control plot were collected immediately before harvest in both 1977 and 1978. These plants were separated into stems, pods, and seeds and weighed individually. The only yield parameter which was consistently lower in the SO_2-treated plots was the average weight per seed, which showed a significant drop in all of the fumigated plots in 1977 and all but one plot in 1978. The number of pods and seeds per plant was lower in most of the more heavily fumigated plots in both years, but because of high within-plot variability differences were statistically only in the 1977 high plot. The number of seeds per pod was apparently not affected by the SO_2 treatment. In both 1977 and 1978 bean quality was affected much less by the fumigation than bean quantity.

21339 (ANL—78-65(Pt.3), pp 5-10) **Evaluation of the sulfur dioxide concentration dynamics from the open air fumigation system.** Miller, J.E.; Sprugel, D.G.; Xerikos, P.B.; Smith, H.J. 1978.

In Radiological and Environmental Research Division: ecology. Annual report, January-December 1978.

The open-air fumigation system (a technique used to treat field plots of crops with air pollutants) was used for the second year in 1978 in the SO_2-crop effects studies. The first report dealing with this technique indicated that the temporal fluctuation in SO_2 concentrations provided to the field plots by the system appeared to resemble actual SO_2 episodes. The 1978 SO_2 concentration data are summarized and compared to published information on short- and long-term SO_2 concentration variability near point sources. Five field plots were treated with SO_2; the frequency, duration, and mean concentration (compiled from 1 min averages at 4 min intervals) of the fumigations are summarized. Standard deviations and standard geometric deviations are reported, although a skewness test indicated that the data are neither normally nor log-normally distributed. The conclusion that the SO_2 treatments were longer and more frequent than occurrences of episodes near point sources was not surprising, since one of the purposes of the studies was to establish the lower limit of chronic SO_2 exposure that would reduce soybean yield. Future experiments will be conducted with exposure frequencies and durations more common in areas moderately polluted with SO_2. The close agreement between the ambient and experimental peak-to-mean concentrations for 1 and 3 hr averaging times supports the contention that the fluctuations in SO_2 episodes during information were similar to actual fumigations.

21340 (ANL—78-65(Pt.3), pp 11-13) **Histological study of soybeans injured by exposure to sulfur dioxide.** Irving, P.M.; Martinson, D.J.; Miller, J.E. 1978.

In Radiological and Environmental Research Division: ecology. Annual report, January-December 1978.

Since it is now known that crop yields may be reduced by exposure to sulfur dioxide without accompanying visible damage, a technique for quantifying both visible and hidden damage to crop plants after exposure to SO_2 would be extremely useful. A preliminary histological study of soybean leaves exposed to SO_2 gas was undertaken to examine the possibility that a microscopic determination of cell death is related to SO_2 exposure and crop yield. Soybean leaf tissue samples were collected from two field plots which had been exposed to a gradient of acute SO_2 concentrations. The results from this preliminary investigation suggest that yield decreases will occur in soybeans when approximately 3.5 to 4% of the leaf cells are killed by SO_2 exposure during an acute episode and that cell death also results from chronic SO_2 exposures, even though visible damage is not observed. (JGB)

21341 (ANL—78-65(Pt.3), pp 14-16) **Estimate of minimum SO_2 deposition velocities in the open-air fumigation system.** Sprugel, D.G.; Miller, J.E.; Xerikos, P.B.; Smith, H.J. 1978.

In Radiological and Environmental Research Division: ecology. Annual report, January-December 1978.

It is possible to estimate the uptake of sulfur dioxide by measuring the increased sulfur content of plants plants exposed to elevated pollutant levels. During the summer of 1978 ths method was used to make an estimate of the deposition velocity for the soybean field plots exposed to SO_2 in the open-air fumigation system. The deposition velocity estimates ranged from 0.5 to 0.9 cm sec^{-1} which is lower than the range generally found under similar conditions by micrometeorological methods. Typical values over rapidly growing fields of agricultural crops are in the range 1.0 to 1.5 cm sec^{-1}, and numerical modelers often use 1.0 cm sec^{-1} as a convenient mean value for all atmospheric and environmental conditions. However, the values given represent minimum estimates for several reasons which are discussed.

21342 (ANL—78-65(Pt.3), pp 17-20) **Effects of acid precipitation alone and in combination with sulfur dioxide on field-grown soybeans.** Irving, P.M.; Miller, J.E. 1978.

In Radiological and Environmental Research Division: ecology. Annual report, January-December 1978.

In view of the increasing prevalence of acid precipitation in the Midwest, a study was undertaken in 1977 to determine its effects, and possible interactions with SO_2, on soybeans, an economically important crop in the Midwest. The findings to date are summarized. Field-grown soybeans were exposed to acid (~ pH 3.1) or control (~ pH 5.3) precipitation simulants in sulfur dioxide fumigated and unfumigated field plots as described previously. No statistically significant effects of the acid or control simulants, nor interactions with SO_2, were found on seed yield in either year, although the plots receiving both precipitation simulant and SO_2 had significantly lower yields (12 to 46%) than plots receiving only precipitation simulant. In 1977 the seed yields were slightly lower in both the fumigated and unfumigated acid-treated plots, when compared to the appropriate controls, while in 1978, yields in the unfumigated, acid-treated plots were somewhat higher. It is interesting to note that the weights of individual seeds were consistent with the yield differences; in 1978 the seed weight in the acid precipitation plot was significantly different from that in plots both with control precipitation and no precipitation. This suggests that the acid treatment in 1978 did, in fact, have an effect on productivity as reflected seed growth. Although visible damage was not apparent in any of the plots, a histological study revealed significant increases in the number of dead leaf cells in all plots, compared to untreated controls, except the one exposed to control precipitation alone.

21343 (ANL—78-65(Pt.3), pp 24-28) **Induction of visible injury in chamber-grown soybeans exposed to acid precipitation.** Irving, P.M. 1978.

In Radiological and Environmental Research Division: ecology. Annual report, January-December 1978.

The determination of threshold concentrations of pollutants that cause visible injury to plants is usually an initial step of documentation of pollution effects. Visible injury has been observed in a number of plant species exposed to acid precipitation at pH values of 3.2 and less. However, response thresholds have not been established, especially with regard to the quantity of acid rain of a given pH that produces visible injury. Therefore, a preliminary investigation was undertaken to determine such thresholds for soybeans. Chamber-grown soybean plants were exposed, ten weeks after germination, to acid (pH 3.0) and control (pH 5.4) precipitation simulants having ionic compositions similar to natural rain. Eight groups of plants were exposed to a range in quantities of precipitation (0.65 to 9.35 cm) within a four day period. Although visible damage was not observed in any of the plants receiving the control simulant, two types of injury, necrotic lesions and chlorotic areas, occured in leaves treated with the acid simulant. The tabulated results indicate that necrotic lesions may occur in young soybean leaves after exposure to as little as 2 cm of acid rain (pH 3.0) when applied at high exposure rates. All treated plants showed necrotic damage after exposure to 7 cm of acid simulant applied in 3 consecutive days.

21344 (BNL—27421) **Foliar responses that may determine plant injury by simulated acid rain.** Evans, L.S. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 19p. (CONF-790573—4). Dep. NTIS, PC A02/MF A01.

From 12. University of Rochester symposium on environmental toxicity: polluted rain; Rochester, NY, USA (21 May 1979).

The aim of the research presented here is to try to use visual, scanning electron micrographs, and histological preparations as tools to predict the relative sensitivity of various plant species to simulated acid rain. It is hope that these results might enable a prediction of the relative sensitivities of major plant groups of economic and aesthetic interest to air pollutants.

21345 (DOE/EV/04368—3) **Effects of sulfur dioxide and nitrogen dioxide on vegetation. Six month progress report, 1 April-30 September 1979.** Weinstein, L.H.; McCune, D.C.; MacLean, D.C.; Laurence, J.A.; Amundson, R.G.; Alscher-Herman, R.; Hughes, P.; Renwick, A. (Boyce Thompson Inst. for Plant Research, Ithaca, NY (USA)). Oct 1979. Contract AS02-77EV04368. 11p. Dep. NTIS, PC A02/MF A01.

Progress in research on the effects of sulfur dioxide and nitrogen dioxide on plants is presented. Specific areas of investigation include: effects of NO_2 on the phytotoxicity of SO_2; interactions of air pollutants, plants and plant pathogens; effects of SO_2 on plant-insect interactions; mode of action and metabolism of SO_2 in plants. (ACR)

21346 (PB—80-103500) **Oxidant air pollution impact to the forests of Eastern United States: a literature review.** Skelly, J.M.; Johnson, J.W. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Dept. of Plant Pathology and Physiology). Apr 1979. 39p. NTIS, PC A03/MF A01.

This report presents a review of past studies that have attempted to delineate measurable and/or possible impacts of photochemical oxidants on the forests of Eastern United States. Sources of oxidant precursors and subsequent long distance transport phenomena are reviewed and documented. A brief historical treatment of eastern white pine responses to air pollutants is followed by an up-to-date evaluations of current air pollution measurements and associated impacts. Potential threats to eastern forest tree species are reviewed through a comparison of various fumigation studies in laboratory and field situations. The concept of hidden injury is discussed as being a possible major impact problem facing analysis of real losses. The authors present evidence that would suggest that many forest tree species indigenous to the Eastern United States may already be detrimentally impacted by previous high oxidant episodes. They further suggest that even more drastic and only long term reversible effects to the forest ecosystem will follow a trend of increasing oxidant air pollution in many major forested regions of this area of the United States.

21347 Energy-linked adenosine diphosphate accumulation by corn mitochondria. General characteristics and effect of inhibitors. Abou-Khalil, S.; Hanson, J.B. (Univ. of Illinois, Urbana). Contract EY-76-S-02-0790. *Plant Physiol.;* **64**: No. 2, 276-280(Aug 1979).

Corn mitochondria show respiration-linked net accumulation of (^{3}H)ADP in the presence of phosphate and magnesium, especially if the formation of ATP is blocked with oligomycin. Inhibition of ADP-ATP exchange by carboxyatractyloside also activates ADP accumulation, and addition of carboxyatractyloside or palmitoyl-coenzyme A to oligomycin-blocked mitochondria produces additional ADP uptake. With carboxyatractyloside the accumulated ADP is phosphorylated to ATP. With oligomycin, only a little ATP is formed. Millimolar concentrations of ADP are required for maximum uptake, and the K/sub m/ (3.77 millimolar) for ADP translocation is independent of whether oligomycin or carboxyatractyloside is used. This is not true for ADP concentrations in the 0.05 to 0.25 millimolar range. Accumulated (^{3}H)ADP rapidly exchanges with unlabeled AMP, ADP, or ATP, but not with other diphosphate nucleotides or 2 millimolar substrate anions. (^{3}H)AMP is not accumulated, but (^{3}H)ATP is accumulated to about one-half the extent of (^{3}H)ADP. Tricarboxylate substrates inhibit ADP net uptake, and inhibition by citrate is competitive with K/sub i/ = 10 millimolar. The evidence suggests the presence of a pathway, carboxyatractyloside-insensitive and different from the translocase, which operates to maintain adenine nucleotides in the matrix.

21348 Energy-linked adenosine diphosphate accumulation by corn mitochondria. Phosphate and divalent cation requirement. Abou-Khalil, S.; Hanson, J.B. (Univ. of Illinois, Urbana). *Plant Physiol.;* **64**: No. 2, 281-284(Aug 1979).

The requirement for phosphate and Mg^{2+} in energy-linked (^{3}H)ADP accumulation by corn mitochondria has been studied. Arsenate will fully substitute for phosphate; sulfate partially substitutes; acetate, bicarbonate, and pyrophosphate are ineffective. Phosphate is also taken up by the mitochondria, but the ADP/Pi ratio varies widely with experimental treatments. ADP does not exchange with endogenous labeled phosphate, although Pi/^{32}Pi exchange occurs. Mg^{2+} is also accumulated during ADP uptake. Mg^{2+} can be substituted with varying efficiency by other divalent cations, but not monovalent cations. Effective cations typically increase phosphate uptake, particularly Ca^{2+}.Ca^{2+}-activated ADP accumulation is insensitive to carboxyatractyloside over a wide range of Ca^{2+} concentrations. When Ca^{2+} is substituted for Mg^{2+} it is not necessary to block ATP formation to secure high levels of ADP accumulation, since Ca^{2+} will divert energy from ATP formation into ion uptake. It is suggested that the transport mechanism may carry out a concerted transport of ADP and phosphate with bound divalent cation. The phosphate transporter may be involved, or alternatively a special mechanism for trivalent anion transport may exist which acts cooperatively with the phosphate transporter.

21349 Production and fate of phytoplankton size fractions in the plume of the Hudson River, New York Bight. Malone, T.C.; Chervin, M.B. (Columbia, Univ., Palisades, NY). Contract EY-76-S-02-2185B. *Limnol. Oceanogr.;* **24**: No. 4, 683-696(Jul 1979).

Seasonal effects of water column stability, phytoplankton growth, and copepod grazing on the biomass of phytoplankton size fractions are described in the context of variations in particulate organic carbon (POC). Net plankton biomass was more variable in time (between weeks and months), while nanoplankton biomass was more variable in space (between surface and bottom layers and between stations). Biomass was highest and most uniformly distributed during February-March when net plankton diatoms dominated and doubling times approximated the flushing time of the plume. Biomass declined rapidly with depth and distance from the mouth of the estuary during June-July when nanoplankton dominated and doubling times were short relative to the flushing time of the plume. Variations in POC were well correlated with phytoplakton biomass when net plankton dominated and biomass was limited by sinking and mixing. When nanoplankton dominated, biomass was limited manly by grazing and correlations between POC and biomass were poor. It appears that most of the biomass produced by net plankton diatoms sinks from the surface layer before the summer thermocline develops, while most of the biomass produced by nanpolankton during the summer enters pelagic food chains before sinking from the surface layer.

INVERTEBRATES

REFER ALSO TO CITATION(S) 20954, 21358

21350 (CONF-800301—4) **Assessment of potential health effects of dielectric gases.** Griffin, G.D.; Easterly, C.E.; Walsh, P.J. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 10p. Dep. NTIS, PC A02/MF A01.

From 2. international symposium on gaseous dielectrics; Knoxville, TN, USA (9 Mar 1980).

Potential health effects of certain fluorinated hydrocarbons considered for gaseous dielectric applications have been examined. Toxicological data are lacking for some of the chemicals of interest. The most extensive studies relate to sulfur hexafluoride and octafluorocyclobutane, both of which appear to be rather nontoxic, for acute exposure situations. Mutagenicity studies with fruit flies have identified octafluorocyclobutane and perfluorobutene-2 as producing sex-linked recessive mutations in this organism. Certain products generated by electric discharge through the dielectric gas mixtures and trace contaminants produced during the manufacturing process may be more toxic than the parent compounds.

VERTEBRATES

REFER ALSO TO CITATION(S) 20090, 21196, 21334, 21335, 21358

21351 Toxicity of selenium to developing Xenopus laevis embryos. Browne, C.L.; Dumont, J.N. (Oak Ridge National Lab., TN). *J. Toxicol. Environ. Health;* **5**: No. 4, 699-709(Jul 1979).

Se in the form of sodium selenite is toxic to Xenopus laevis embryos and tadpoles continuously exposed to concentrations above 1 ppM. Concentrations of 2 ppM and above result in severe developmental abnormalities and increased mortality. Uptake and loss of radioactive Se from water are rapid, but depuration is not complete, indicating that some Se can remain bound by the organism. The facts that Se is toxic at low levels to Xenopus embryos and tadpoles, can cause developmental abnormalities, and accumulates in tissues suggest that increased release of Se compounds into the environmental poses a potential threat to aquatic organisms.

21352 Lead and calcium distributions in blood, plasma, and milk of the lactating mouse. Keller, C.A.; Doherty, R.A. (Univ. of Rochester School of Medicine and Dentistry, NY). *J. Lab. Clin. Med.;* **95**: No. 1, 81-89(Jan 1980).

Although it has been established that lead is transferred in milk from mother to suckling offspring, the physiological processes and parameters involved are not well understood. Single i.v. doses (0.2 mg/kg) or p.o. doses (2 mg/kg) of radiolabeled lead were administered to lactating and nonlactating female mice, and lead concentrations in blood, plasma, and milk were determined during a 21-day period. Large differences in lead elimination were observed between lactating and nonlactation mice. A significant fraction (25%) of the initial maternal dose (absorbed dose) was transferred to the suckling pups. The ratio of lead concentration in milk to lead concentration in plasma was found to be nearly constant over time.

However, the milk-to-blood concentration ratios decreased during the same period. Furthermore, the concentration of lead in milk exceeded the plasma concentration by a factor of approximately 25, indicating that there is a physiological process(es) which establishes a large milk-to-plasma concentration ratio. A similar calcium concentration ratio was also observed. It is concluded that plasma lead concentration is a more accurate index for the estimation of milk lead concentration than is whole blood lead concentration.

21353 Toxicity of 0.4- and 0.8-μm sulfuric acid aerosols in the guinea pig. Wolff, R.K.; Silbaugh, S.A.; Brownstein, D.G.; Carpenter, R.L.; Mauderly, J.L. (Inhalation Toxicology Research Inst., Albuquerque, NM). Contract EY-76-C-04-1013. *J. Toxicol. Environ. Health;* **5**: No. 6, 1037-1047(Nov 1979).

To determine mortality caused by inhaled sulfuric acid mist, groups of Hartley guinea pigs 2 to 3 months old were exposed for 8 h to graded concentrations of aerosols of 0.4 or 0.8 μm mass median aerodynamic diameter. Relative humidity during exposures was maintained at 70 to 80%. Based on probit analysis, the concentration required to produce 50% mortality (LC50) for deaths to 21 d after exposure was 30 mg/m^3 for the 0.8-μm aerosol. For the 0.4-μm aerosol, the LC50 was above 109 mg/m^3, the highest concentration obtainable at that particle size. At both particle sizes, the animals either tended to develop severe dyspnea and die minutes (0.4 μm) or hours (0.8 μm) thereafter or appeared nearly unaffected. Lesions in animals that died as a result of 0.8-μm exposures also showed hemorrhage and transudation. No gross or histopathologic changes were observed in animals that appeared unaffected during exposure. Differences in total and/or regional respiratory tract deposition may account for the different responses to the two aerosols.

21354 . Distribution, retention, and elimination of pyrene in rats after inhalation. Mitchell, C.E.; Tu, K.W. (Inhalation Toxicology Research Inst., Albuquerque, NM). *J. Toxicol. Environ. Health;* **5**: No. 6, 1171-1179(Nov 1979).

Pyrene was measured in tissues of Fischer 2344 rats at various times after inhalation of pyrene aerosols (500 μg/l; mass median diameter, 0.3 to 0.8 μm) for 1 h. Significant quantities of pyrene were found in nasal turbinates, trachea, lungs, kidney, and liver immediately after exposure. Clearance from the respiratory tract was rapid; concentrations in the trachea and lungs 48 h after exposure were 20 and 5% of the concentrations present 1/2 h after exposure. Pyrene also cleared from liver and kidney at a relatively rapid rate; concentrations in these tissues 48 h after exposure were approximately 10% of those 1/2 h after exposure. Concentrations in the gastrointestinal tract 24 h after exposure were 4 times those found 1/2 h after exposure. Pyrene cleared from the gastrointestinal tract approximately 4 d after exposure. Thus, inhaled pyrene is rapidly cleared from the respiratory tract by mucociliary action from the trachea and bronchi and by translocation from the respiratory tract to the liver and kidney; it is eliminated primarily through the gastrointestinal tract.

21355 Cadmium-induced alterations in RNA metabolism in cultures of Chinese hamster cells sensitive to and resistant to the cytotoxic effects of cadmium. Enger, M.D.; Campbell, E.W.; Ratliff, R.L.; Tobey, R.A.; Hildebrand, C.E.; Kissane, R.J. (Los Alamos Scientific Lab., NM). *J. Toxicol. Environ. Health;* **5**: No. 4, 711-728(Jul 1979).

A variant population (CdR) of cultured Chinese hamster cells (line CHO) was derived that is more than 100 times as resistant to the cytotoxic effects of Cd^{2+} than is the parent population. The effects on RNA metabolism of exposure to sublethal concentrations of Cd^{2+} were studied in CHO and CdR. Exposure to 2×10^{-7} M $CdCl_2$ for 24 h resulted in increased polysome content (1.2 times) and increased uridine or adenosine incorporation into heterogeneous nuclear RNA (1.2 to 1.4 times) and messenger RNA (1.5 to 1.7 times) in both populations. Measurement of ATP pool specific activity following exposure to radiolabeled adenosine showed that increased incorporation reflects increased synthesis. The equivalence of CHO and CdR in dose-response in terms of stimulated RNA synthesis and their disparity in dose-response in terms of cytotoxic effects indicate that the systems involved in conferring protection against the lethal effects of Cd^{2+} are not similarly involved in attenuating the effects on RNA metabolism.

MAN

REFER ALSO TO CITATION(S) 20043, 20090, 21212

21356 (PB—80-107030) Model for measuring the health impact from changing levels of ambient air pollution: morbidity study. Namekata, T.; Carnow, B.W.; Flournoy-Gill, Z.; O'Farrell, E.B.; Reda, D. (Illinois Univ., Chicago (USA). School of Public Health). Aug 1979. Contract EPA-68-02-2492. 74p. NTIS, PC A04/MF A01.

The study quantitatively examines the relationship between human health and ambient air concentrations of the major pollutants in the city of Chicago. This report describes the morbidity analysis in which linear regression models have been developed to quantitatively estimate the degree of the air pollution contribution to emergency room visits for cardiac and respiratory diseases in two major hospitals in the city of Chicago. Based on the significant associations between the pollutants and the disease groups, holding climatological and days-of-week variables constant, the variation due to the pollutant is estimated. According to the results, sulfur dioxide based on patient exposure levels can account for about 13% of the variation of emergency room visits for acute bronchial and lower respiratory infections and about 22% for total cardiac diagnoses. Nitric oxide based on measurements from the closest site to the hospitals can account for about 7% of the variation of visits for total respiratory diagnoses, 6% for allergic conditions and upper respiratory infections, 4% for total cardiac diagnoses and 4% for hypertension and vascular heart diseases. Total suspended particulate, carbon monoxide and ozone do not show significant associations with any disease groups.

21357 (PB—80-113194) U.S. ground troops in South Vietnam were in areas sprayed with herbicide orange. (General Accounting Office, Washington, DC (USA). Federal Personnel and Compensation Div.). 16 Nov 1979. 23p. NTIS, PC A02/MF A01.

Between 1966 and 1969 a large number of U.S. ground troops in Vietnam were in areas sprayed with herbicide orange both during and shortly after spraying. DOD took few precautions to prevent exposure because at that time it did not consider the herbicide to be toxic or dangerous to humans. Marines assigned to units in sprayed areas can be identified, but Army personnel cannot because Army records are incomplete. Troops' actual exposure or the degree of exposure to the herbicide cannot be documented from available records. Also, the long-term efects of exposure remain largely unknown. The Congress should direct DOD, VA, HEW, or the Environmental Protection Agency to determine whether a study is needed of the health effects of herbicide orange on ground troops discussed in this report. GAO issued this report at the request of Senator Charles Percy, Ranking Minority Member of the Permanent Subcommittee on Investigations, Senate Committee on Governmental Affairs.

21358 (PB—80-802895) Asbestos and silicate pollution. Volume 2, 1977-November, 1979 (citations from the NTIS data base). Report for 1977-November 1979. Cavagnaro, D. (National Technical Information Service, Springfield, VA (USA)). Dec 1979. 219p. NTIS PC N01/MF N01.

This bibliography cites Federally-funded research reports on air and water pollution by silica, asbestos, silicates, and silicon dioxide. The citations cover sources, control, detection, and effects on plants, animals, and humans (silicosis, asbestosis, and toxicity). (This updated bibliography contains 212 abstracts, 77 of which are new entries to the previous edition.)

21359 Human biochemical response to ozone and vitamin E. Posin, C.I.; Clark, K.W.; Jones, M.P.; Buckley, R.D.; Hackney, J.D. (Rancho Los Amigos Hospital, Downey, CA). *J. Toxicol. Environ. Health;* **5**: No. 6, 1049-1058(Nov 1979).

To determine whether vitamin E (dl-α-tocopherol) supplementation of the diet provides protection from inhaled oxidants such as ozone (O_3) in community air pollution, its effects were studied in healthy adult volunteers. Experimental groups received 800 or 1600 IU of vitamin E for 9 weeks or more; control groups received placebos. Double-blind conditions were maintained throughout the study. Biochemical parameters studied included red blood cell fragility; hematocrit and hemoglobin values; red cell glutathione concentration; and the enzymes acetylcholinesterase, glucose-6-phosphate dehydrogenase, and lactic acid dehydrogenase. No significant differences between the responses of the supplemented and placebo groups to a controlled O_3 exposure (0.5 ppM for 2 h) were found for any of these parameters. The results indicate that vitamin E supplementation in humans, at the levels employed in this experiment, gives no added protection against blood biochemical effects of O_3 in intermittently exercising subjects under exposure conditions simulating summer ambient air pollution episodes.

21360 Interactions of blood metalloproteins with nitrogen oxides and oxidant air pollutants. Case, G.D.; Dixon, J.S.; Schooley, J.C. (Univ. of California, Berkeley). *Environ. Res.;* **20**: No. 1, 43-65(Oct 1979).

The effects of in vitro exposure of fresh blood and in vivo exposure of animals to atmospheres containing NO, NO_2, or O_3 were examined on the iron- and copper-containing proteins in whole blood by low-temperature EPR spectroscopy. Exposure of whole blood to NO under conditions in which neither free nor bound O_2 is present results in the quantitative conversion of Hb to the Hb-NO derivative. Subsequent exposure of the derivative to air converts nearly all of the Hb-NO to methemoglobin in the reaction whose mechanism is detailed in this report. Nitrite seems to participate only in the terminal stages. In vivo exposure of animals to air containing a few parts per million NO or NO_2 gives rise to significant accumulations of both Hb-NO and methemoglobin, the latter being the major

product. This effect can be seen under typical ambient conditions. Exposure to NO_2, either aerobically or anaerobically, gives rise to a mixture of Hb-NO and methemoglobin in the ratio which ranges between 1:4 and 1:20. Methemoglobin is invariably the major product. Exposure to O_3, on the other hand, fails detectably to alter the state of hemoglobin in whole blood, nor does O_3 generate a measurable change in organic free radicals. All three gases - NO, NO_2, and O_3 - significantly increase the signal due to high-spin (anti S = 5/2) ferric catalase, while NO, NO_2, and O_2 all depress the level of iron transferrin. These effects translate into decreased activity for both proteins. Other metalloproteins in blood which are observable by EPR spectroscopy are, for the most part, insensitive to NO, NO_2, or O_3. The implications of these chemical changes in terms of health effects of NO/sub x/ and oxidant air pollution are discussed.

OTHER ENVIRONMENTAL POLLUTANT EFFECTS

REFER ALSO TO CITATION(S) 20586, 20587, 20588, 21263

21361 (AD-A—073191) **Effects of 60 Hz environmental electric fields on the mammalian central nervous system. Report no. 1 (final) Oct 1975-Sep 1977.** Adey, W.R.; Bawin, S.M.; Sagan, P.M. (California Univ., Los Angeles (USA). Brain Research Inst.). 3 Apr 1979. Contract N00014-76-C-0421. 55p. NTIS, PC A04/MF A01.

Groups of 10 male rats were exposed to vertical 60 Hz electric fields of 0, 50, 500, 1000 V/m for 30d. Duplicate tests were run for 0, 500, 1000 V/m. Subjects lived in a plastic test facility for 7d prior and for 7d following exposure. Body weight, water consumption, food consumption, urine output and general activity were measured. Urine from 6 animals was obtained by fraction collection; all samples for selected days were tested by atomic absorption for K, Na and Ca. Following the experiment, subjects from 500 and 1000 V/m conditions were sacrificed; thyroid and adrenal tissues were weighed; intracardiac blood samples were fully analyzed. Most measures showed no statistically significant differences between experimentals and controls or between experimentals exposed to the various field strengths. Two activity measurements showed field effects: (1) size and duration of nighttime activity bout was reduced in the 1000 V/m condition, from the other conditions during initial exposure; (2) relative activity during the 0900-1000 period was consistently but not significantly greater in the 1000 V/m condition than the other conditions throughout exposure. Urine electrolyte data did not suggest altered steroid excretion as a result of exposure.

HEALTH AND SAFETY

21362 (NCRP—61) **Radiation safety training criteria for industrial radiography.** (National Council on Radiation Protection and Measurements, Washington, DC (USA)). 1 Nov 1978. 32p. NCRP Publications, Washington, DC.

This report is intended as a guide for training persons in the safe use of sources of radiation for industrial radiography. Industrial radiography personnel require continuing effective training in radiation safety principles and procedures in order to maintain routine exposures at a low level and to reduce accidental overexposures. Three phases of training are delineated in the report: initial training, on-the-job training, and periodic training. An outline of topics to be considered under each of the training categories, as well as recommendations relevant to the particular category are presented.

21363 (PUB—334) **Supervisor's accident investigation handbook.** (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Feb 1980. Contract W-7405-ENG-48. 27p. Dep. NTIS, PC A03/MF A01.

This pamphlet was prepared by the Environmental Health and Safety Department (EH & S) of Lawrence Berkeley Laboratory (LBL) to provide LBL supervisors with a handy reference to LBL's accident investigation program. The publication supplements the Accident and Emergencies section of LBL's Regulations and Procedures Manual, Pub. 201. The present guide discusses only accidents that are to be investigated by the supervisor. These accidents are classified as Type C by the Department of Energy (DOE) and include most occupational injuries and illnesses, government motor-vehicle accidents, and property damages of less than $50,000.

GEOSCIENCES

GEOLOGY AND HYDROLOGY

REFER ALSO TO CITATION(S) 20164, 20172, 20173, 20180, 20181, 20190, 20191

GEOPHYSICS

SEISMOLOGY AND TECTONICS

REFER ALSO TO CITATION(S) 20160

21364 (AD-A—072956) **Event identification - applications to area of interest events. Technical report.** Sax, R.L.; Bell, A.G.R.; Dietz, D.L.; Strauss, A.C.; Shaub, J.S. (Texas Instruments, Inc., Dallas (USA)). 13 Nov 1978. Contract F08606-77-C-0004. 194p. NTIS, PC A09/MF A01.

An integrated event identification system has been developed to operate on an 'Area of Interest' data base. This system includes an automated measurement and analysis section using the IBM 360/44 computer and an interactive editing and identification section using the PDP-15/50 computer. Amplitude measurements are made on both short-period and long-period data and serve as the basis for computing most of the discriminants. Other discriminants include mean instantaneous frequency and mean instantaneous phase standard deviation, and complexities. Ringdal's maximum likelihood technique is used to generate 'unbiased' event measurements from the individual station measurements obtained for each event. At present, a set of 35 events has been processed with this system. A multivariate analysis technique was used to classify the events either as earthquakes or as particular types of anomalous events. The results indicate that the system makes it possible to achieve good separation between anomalous events and a selected set of normal shallow-depth earthquakes.

21365 (LA—8270-MS) **Intermediate simulation of the inverse seismic problem.** Brolley, J.E. (Los Alamos Scientific Lab., NM (USA)). Mar 1980. Contract W-7405-ENG-36. 22p. Dep. NTIS, PC A02/MF A01.

An introductory study of the inverse seismic problem is performed. The complex cepstrum of a seismogram generated by the convolution of three factors, the Seggern-Blandford source function of an explosion, the Futterman mantle transfer function, and the SRO seismometer transfer function, is used. For a given Q and yield, a synthetic seismogram is computed. Arbitrary values of Q and yield are introduced, and a search is conducted to find that pair of values that minimized the cepstral difference between the original and arbitrary seismograms. The original values are accurately recovered. Spectral and amplitude characteristics of the various factors are presented. Possible application to the problem of studying a medium intervening between a source and receiver is discussed. 25 figures, 1 table.

21366 (UCRL—15227) **Seismic Safety Margins Research Program, Phase I. Project II: seismic input. Compilation, assessment and expansion of the strong earthquake ground motion data base.** Crouse, C.B.; Hileman, J.A.; Turner, B.E.; Martin, G.R. (Fugro, Inc., Long Beach, CA (USA)). Apr 1980. Contract W-7405-ENG-48. 143p. Dep. NTIS, PC $12.50/MF $3.65.

A catalog has been prepared which contains information for: (1) world-wide, ground-motion accelerograms, (2) the accelerograph sites where these records were obtained, and (3) the seismological parameters of the causative earthquakes. The catalog is limited to data for those accelerograms which have been digitized and published. In addition, the quality and completeness of these data are assessed. This catalog is unique because it is the only publication which contains comprehensive information on the recording conditions of all known digitized accelerograms. However, information for many accelerograms is missing. Although some literature may have been overlooked, most of the missing data has not been published. Nevertheless, the catalog provides a convenient reference and useful tool for earthquake engineering research and applications.

GEOPHYSICAL SURVEY METHODS

REFER ALSO TO CITATION(S) 21365

MINERALOGY, PETROLOGY, AND ROCK MECHANICS

REFER ALSO TO CITATION(S) 20220, 21051, 21371

21367 (SAND—79-1582C) **Numerical studies of rock fragmentation.** Kipp, M.E.; Grady, D.E. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 20p. (CONF-800701—1). Dep. NTIS, PC A02/MF A01.

From 2. international conference on numerical methods in fracture mechanics; Swansea, UK (6 Jul 1980).

The dynamic fracture process in rock has been modelled as a continuous accrual of damage, where the damage is defined to be the volume fraction of material that has been stress relieved by multiple crack growth. A rate equation, governing the growth of the damage, has been formulated based upon a microstructural analysis of crack growth rates and Weibull crack distribution concepts. For a prescribed tensile loading history, damage levels and fragment sizes can be obtained. In most geometries of explosive applications, there are large spatial variations in loading histories which lead to a variation in fragment sizes. Using a two-dimensional finite-difference wave-propagation code and fracture parameters for oil shale, calculations of several configurations of explosives illustrate the resulting damage to surrounding rock.

GEOCHEMISTRY

21368 (LA—8265-MS) **Compilation of elemental concentration data for United States Geological Survey's eight new rock standards.** Gladney, E.S. (Los Alamos Scientific Lab., NM (USA)). Mar 1980. Contract W-7405-ENG-36. 60p. Dep. NTIS, PC A04/MF A01.

Elemental composition data on BHVO-1, MAG-1, QLO-1, RGM-1, SCo-1, SDC-1, SGR-1, and STM-1 were collected from 62 journal papers and reports. All individual data, their uncertainties, and analytical technique used are reported for 68 elements. These data are summarized into mean values with standard deviation. The standard rock designations, their description and source are as follows: BHVO-1 - basalt from Kilauea Crater; MAG-1 - marine mud from the Gulf of Maine; QLO-1 - quartz latite for southeastern Oregon; RGM-1 - rhyolite from Glass Mountain, California; SCo-1 - Cody shale from Natrona County, Wyoming; SDC-1 - mica schist from Rock Creek Park, Washington, DC; SGR-1 - Green River shale from Wyoming; and STM-1 - nepheline syenite from Table Mountain, Oregon. 66 references, 13 tables.

21369 **Characterization of plant tissues by their lignin oxidation products.** Hedges, J.I.; Mann, D.C. (Univ. of Washington, Seattle). *Geochim. Cosmochim. Acta;* **43**: No. 11, 1803-1807(Nov 1979).

The cupric oxide oxidation products of 23 vascular and nonvascular plant tissues have been measured. Compositional data for vanillyl, syringyl, and cinnamyl phenols are presented in the form of five lignin parameters which are related to plant variety, lignin concentration, and tissue type. On the basis of these parameters, the 23 plant tissue samples are resolved into distinct compositional regions corresponding to: (a) nonvascular plants, (b) gymnospherm woods, (c) nonwoody gymnospherm tissues, (d) angiosperm woods, and (e) nonwoody angiosperm tissues. The same five parameters also can be determined for organic materials in soils and sediments and used either to discriminate between compositionally different organic mixtures or to estimate the relative amounts of each of the above types of plant materials in the deposits.

21370 **Lignin geochemistry of marine sediments from the southern Washington coast.** Hedges, J.I.; Mann, D.C. (Univ. of Washington, Seattle). *Geochim. Cosmochim. Acta;* **43**: No. 11, 1809-1818(Nov 1979).

Lignin oxidation products and stable carbon isotope distributions are used to investigate the sources, transport, and chemical stability of land-derived organic matter in dated cores of modern sediment from the southern Washington State continental shelf and slope. There is no evidence for significant chemical alteration of lignin compounds in these sediments for time periods of up to 400 y. Gymnosperm woods and nonwoody angiosperm tissues account for most of the land-derived organic matter in the deposits. These land plant remains have an average $\delta^{13}C$ of approximately -25.5 0/00 and are concentrated in a narrow band of silty sediment which extends northward from the Columbia River mouth along the mid-shelf. Marine organic matter having an approximate $\delta^{13}C$ of -25.5 0/00 strongly predominates in most other shelf and slope environments. Net fluxes of land-derived organic matter into the surface 5 cm of the cores vary directly with sediment accumulation rates. New fluxes of marine organic material into the surface sediments are highest in environments which favor the preservation of organic matter, but correspond to less than 1% of the primary productivity in the overlying waters.

21371 **Rare earths in the Marcy and Morin anorthosite complexes.** Seifert, K.E.; Voigt, A.F.; Smith, M.F.; Stensland, W.A. (Ames Lab., IA). *Can. J. Earth Sci.;* **14**: 1033-1045(1977).

Instrumental neutron activation analysis (INAA) of rare earth element (REE) abundances for a northern portion of the main Adirondack (Marcy) anorthosite and the adjacent Tupper-Saranac mangerite indicates they are genetically unrelated. Marcy anorthosite characteristically has low REE abundances and a positive europium (Eu) anomaly and a thin discontinuous border facies with no Eu anomaly. Tupper-Saranac mangerite has a lower mafic-rich portion with a relatively low REE abundance and a positive Eu anomaly, and an upper quartz-rich portion with a higher REE abundance and a negative Eu anomaly. A thin border facies of basal mangerite has an intermediate REE abundance and no Eu anomaly. These data are best interpreted in terms of separate magmas and differentiation within the mangerite body. Rare earths were also determined for some Morin Complex rocks. The Sm/Eu ratio from the INAA data agrees well with that calculated from individual minerals for the early crystallized, lower mafic-rich portion of the Tupper-Saranac mangerite, but poorly for the later crystallized, upper quartz-rich portion. The poor agreement between calculated and experimental Sm/Eu ratios in the quartz mangerite is probably due to depletion of Eu relative to Sm during crystallization of the magma, and supports a differentiative relationship between the mafic and quartz mangerite units. 5 figures, 2 tables.

PHYSICS RESEARCH

ASTROPHYSICS AND COSMOLOGY

COSMIC RADIATION

REFER ALSO TO CITATION(S) 21374

21372 (LA-UR—80-928) **Lunar radionuclide records of average solar-cosmic-ray fluxes over the last ten million years.** Reedy, R.C. (Los Alamos Scientific Lab., NM (USA)). 21 Mar 1980. Contract W-7405-ENG-36. 44p. (CONF-7910123—4). Dep. NTIS, PC A03/MF A01.

From Lunar and Planetary Institute topical conference on the ancient sun; Boulder, CO, USA (Oct 1979).

Because changes in solar activity can modify the fluxes of cosmic-ray particles in the solar system, the nature of the galactic and solar cosmic rays and their interactions with matter are described and used to study the ancient sun. The use of cosmogenic nuclides in meteorites and lunar samples as detectors of past cosmic-ray variations are discussed. Meteorite records of the history of the galactic cosmic rays are reviewed. The fluxes of solar protons over various time periods as determined from lunar radionuclide data are presented and examined. The intensities of solar protons emitted during 1954 to 1964 (11-year solar cycle number 19) were much larger than those for 1965 to 1975 (solar cycle 20). Average solar-proton fluxes determined for the last one to ten million years from lunar ^{26}Al and ^{53}Mn data show little variation and are similar to the fluxes for recent solar cycles. Lunar activities of ^{14}C (and preliminary results for ^{81}Kr) indicate that the average fluxes of solar protons over the last 10^4 (and 10^5) years are several times larger than those for the last 10^6 to 10^7 years; however, cross-section measurements and other work are needed to confirm these flux variations.

21373 **^{40}Ar-^{39}Ar dating of inclusions from IAB iron meteorites.** Niemeyer, S. (Univ. of California, Berkeley). *Geochim. Cosmochim. Acta;* **43**: No. 11, 1829-1840(Nov 1979).

Silicate and troilite from IAB iron meteorites were dated by the ^{40}Ar-^{39}Ar technique. Silicate from four IAB meteorites gave well-defined apparent-age plateaus which accounted for 71 to 99% of the release ^{39}Ar. At low temperatures, only Copiapo showed appreciable loss of ^{40}Ar, while Mundrabilla and Woodbine released excess ^{40}Ar. The plateau ages are 4.50 By for Copiapo, 4.57 By for Mundrabilla, 4.57 By for Woodbine, 4.54 By for unetched Pitts, and 4.57 By for etched Pitts; the 1σ error in each case is +- 0.03 By. A poorly defined age plateau for Landes gives an age of 4.48 By, while the total K-Ar age (4.55 By) is significantly higher. The average ($^{40}Ar/^{36}Ar$)/sub trapped/ ratio for all silicate samples is 0.4 +- 0.4. Plateau ages of IAB silicates are as old as or older than the mean age of unshocked chondrites (4.47 By). Troilite samples yielded complex patterns which were evaluated via $^{40}Ar/^{36}Ar$ vs $^{39}Ar/^{36}Ar$ plots. Data for Pitts troilite are consistent with silicate and troilite retaining Ar at about the same time initially, but then 4.25 By ago nearly all the Ar in troilite was redistributed. The 700 to 1000°C points for Mundrabilla troilite define a line which gives an age of 6.2 By and ($^{40}Ar/^{36}Ar$)/sub trapped/ = 42. This line may be an artifact, perhaps produced by homogenization of Ar and K. Approximate estimates of cosmic-rayexposure ages are 240 My for Landes, 130 My for Copiapo, 190 My for Woodbine, 170 My for Mundrabilla troilite, and 60 My for Pitts troilite. An I-Xe study of these same samples has revealed a good correlation between well-defined I-Xe ages of silicates and Ni contents of metal. The poorer resolution of the ^{40}Ar-^{39}Ar technique hampers a similar evaluation; nevertheless,

plateau ages of the silicates suggest a systematic trend with Ni contents. 7 figures, 3 tables.

SOLAR PHENOMENA

21374 (PB—80-107105) **Solar-geophysical data number 420, August 1979. Part II (Comprehensive reports). Data for February 1979, January 1979.** Coffey, H.E. (National Geophysical and Solar-Terrestrial Data Center, Boulder, CO (USA)). Aug 1979. 125p. NTIS, PC A06/MF A01.

This comprehensive report provides data for February 1979 on active regions, synoptic solar maps, solar radio emission, energetic solar particles and plasma, and solar x-ray radiation. It also provides synoptic charts and abbreviated calendar record for January 1979. The miscellaneous data include solar radio emission, cosmic rays-April and May 1979, Solar flares-January 1979, and regional flare index - December 1978.

PLANETARY PHENOMENA

REFER ALSO TO CITATION(S) 20994

ATMOSPHERIC PHYSICS

21375 **Thermospheric energetics and a possible explanation of some observations of geomagnetic disturbances and radio aurorae.** Newell, R.E. (Massachusetts Inst. of Tech., Cambridge). *Nature (London);* **211**: No. 5050, 700-703(13 Aug 1966).

Investigations have concentrated on the following seven items: (a) meridional cross-sections of the zonal wind component; (b) the horizontal transport of angular momentum towards the poles, proportional to the covariance between the zonal and meridional wind components; (c) meridional cross-sections of temperature; (d) the horizontal transport of heat energy towards the poles, proportional to the covariance between the meridional wind component and the temperature; (e) meridional cross-sections of radiative heating and cooling rates; (f) meridional cross-sections of the distribution of trace substances; (g) the horizontal transport of trace substances towards the poles, proportional to the covariance between the meridional wind component and the concentration of the trace substances.

AURORAL AND IONOSPHERIC PHENOMENA

21376 (PB—80-106974) **Auroral electrojet magnetic activity indices AE(11-12) for January-June 1975.** Allen, J.H.; Abston, C.C.; Salazar, J.E.; McKinnon, J.A. (World Data Center A for Solar-Terrestrial Physics, Boulder, CO (USA)). Aug 1979. 119p. NTIS, PC A06/MF A01.

The Auroral Electrojet index (AE) is discussed and a brief description is given of the derivation of 11-12 station 1.0-min AE indices for January-June 1975. Tables are given of hourly average indices for each day, of the stations making the main contribution to the hourly indices, and of the average monthly quiet-time level of horizontal fields (H) at each magnetic observatory. Graphs of the index variations are included for each day of the first half of 1975 and for the frequency and amplitude of extreme variations at each site.

MAGNETOSPHERIC PHENOMENA

21377 (LA—7842-T) **Plasma boundary layer and magnetopause layer of the earth's magnetosphere.** Eastman, T.E. (EG and G, Inc., Los Alamos, NM (USA)). Jun 1979. Contract W-7405-ENG-36. 264p. Dep. NTIS, PC A12/MF A01.

Thesis.

IMP 6 observations of the plasma boundary layer (PBL) and magnetopause layer (MPL) of the earth's magnetosphere indicate that plasma in the low-latitude portion of the PBL is supplied primarily by direct transport of magnetosheath plasma across the MPL and that this transport process is relatively widespread over the entire sunward magnetospheric boundary.

21378 **Plasma acceleration at the earth's magnetopause: evidence for reconnection.** Paschmann, G. (Max-Planck-Institut fuer Physik und Astrophysik, Garching, Germany); Sonnerup, B.U.O.; Papamastorakis, I.; Sckopke, N.; Haerendel, G.; Bame, S.J.; Asbridge, J.R.; Gosling, J.T.; Russell, C.T.; Elphic, R.C. *Nature (London);* **282**: No. 5736, 243-246(15 Nov 1979).

A characteristic of magnetic field reconnection is the acceleration of plasma as it flows across a rotational discontinuity. At the earth's magnetopause this effect has been observed only recently during a few magnetopause crossings by the ISEE satellites. For one example analyzed in detail, the results show good agreement with theoretical predictions. 4 figures.

ATOMIC, MOLECULAR, AND CHEMICAL PHYSICS

21379 (UCRL—15202) **Laser triggered spark gap using fiber optic transmission.** Harjes, H.C. (Texas Tech Univ., Lubbock (USA). Dept. of Electrical Engineering). 12 Dec 1979. Contract W-7405-ENG-48. 79p. Dep. NTIS, PC A05/MF A01.

The use of an optical fiber in a laser triggering system is described. The fiber transmits a high power ruby laser pulse which triggers a high voltage spark gap. The spark gap is a gas switch on a water dielectric Blumlein generator which is pulse charged by a three stage Marx bank. Typical operating parameters for the spark gap are: 2 cm gap, 2700 Torr pressure, Ar-N_2 gas mixture, and a charging voltage of 200 kV. The single strand, 1 mm, quartz, optical fiber is selected specifically for high power transmission capability. Laser pulses of 4 MW are coupled into and transmitted by the fiber with no observed damage. The overall optical system transmission efficiency is 62%. The triggering performance of the system is excellent in that switching delays of less than 10 ns and subnanosecond jitters are measured.

BEAMS AND THEIR REACTIONS

21380 (NVO—1603-2) **Photolytic production of excited states and collisional phenomena for laser fusion applications. Annual report, 11 September 1978-10 September 1979.** Hawkins, R.T.; Rhodes, C.K. (Illinois Univ., Chicago (USA). Dept. of Physics). Dec 1979. Contract AS08-78DP40025. 137p. (DOE/DP/40025—2). Dep. NTIS, PC A07/MF A01.

Several studies involving the development and use of high spectral brightness rare gas halogen sources are presented. At 248 nm, a source whose spectral width and beam divergence approach the fundamental limits of physical optics is described. This device is clearly scalable to terawatt power levels. Such high brightness devices can be readily utilized to examine a broad range of atomic and molecular phenomena pertinent to laser development. These studies include state specific kinetic processes, excited state photoionization, electron collisional mechanisms, and a variety of multiquantum processes.

21381 (UCRL—52925) **Theory of atomic motion in resonant radiation.** Cook, R.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Mar 1980. Contract W-7405-ENG-48. 138p. Dep. NTIS, PC A07/MF A01.

Thesis.

Atomic motion in resonant and near resonant electromagnetic radiation is investigated theoretically. The exposition begins with a study of atomic motion in a resonant standing light wave, with a view toward isotope separation by selective photodeflection, and proceeds to the investigation of more general problems of atomic motion in resonant radiation. The body of the work consists of six chapters, each of which was prepared as a manuscript for publication in the open literature.

21382 **Effects of correlated lattice vibrations on surface backscattering yields.** Jackson, D.P. (Atomic Energy of Canada Ltd, Chalk River, Ontario); Barrett, J.H. *Phys. Lett., A;* **71**: No. 4, 359-360(14 May 1979).

Equal-time displacement correlations are shown to predict significantly reduced ion backscattering yields from the surface of crystalline solids in comparison to yields without correlations.

21383 **Cutoffs and shadows in classical scattering of atoms from surfaces.** Greene, E.F.; Mason, E.A. (Brown Univ., Providence, RI). *Surf. Sci.;* **75**: 549-560(1978).

A commonly used model for the scattering of atoms from crystalline surfaces is that of a classical hard sphere interacting with a hard, corrugated surface. This model is simple emough to permit the study of the effect on the scattering of variation of parameters of the model. Changes in the amplitude and symmetry of the corrugations, the size of the sphere, and the depth of an attractive well near the surface modify the scattering. It is shown how edge effects due to shadowing of parts of the surface and second hits by the sphere distort the classical rainbow structure. The results are shown as topological and intensity plots for special cases. The edge effects give new information on the structure of the surface. For suitable real systems, experimental measurement of the angular and energy dependence of the fraction of the scattering that is elastic may show some of the features described.

ATOMIC AND MOLECULAR PROPERTIES

REFER ALSO TO CITATION(S) 21028, 21394

21384 (ANL-CEN-RSD—80-1) **Tables of thermodynamic functions for gaseous thorium, uranium, and plutonium oxides.** Green,

D.W. (Argonne National Lab., IL (USA)). Mar 1980. Contract W-31-109-ENG-38. 20p. Dep. NTIS, PC A02/MF A01.

Measured and estimated spectroscopic data for thorium, uranium, and plutonium oxide vapor species have been used with the methods of statistical mechanics to calculate thermodynamic functions. Some inconsistencies between spectroscopic data and some thermodynamic data have been resolved by recalculating ΔH°/sub f/ (298.15°K) values for the vapor species of these oxides. Evaluation of the uncertainties in data, methods of estimating molecular parameters, and effects of assumptions have been discussed elsewhere. The tables of thermodynamic functions that were reported earlier have been revised principally because the low-frequency vibrational modes of UO_2 and UO_3 have now been measured. These new empirical data resulted in changes in the electronic contributions to the calculated thermodynamic functions of UO_2 and the estimated vibrational contributions for PuO_2. In addition, some minor changes have been made in the methods of calculation of the electronic contributions for all molecules.

COLLISION PHENOMENA

REFER ALSO TO CITATION(S) 19998

21385 (AD-A—075394) **Annual summary of molecular beam studies of low energy reactions. Annual summary report.** Neynaber, R.H.; Tang, S.Y. (IRT Corp., San Diego, CA (USA)). 15 Oct 1979. Contract N00014-74-C-0011. 5p. NTIS, PC A02/MF A01.

The annual summary of the research performed under ONR Contract No. N00014-74-C-0011 is given. The report describes merging and crossed-beam studies of chemi-ionization and/or ion-molecule reactions. Included are investigations of the He(*) - D, Ne(*) - Xe, Ar(*) - Kr(*), Ne(*) - Ar(*), He(*) - Ne(*), and Kr(+) - Cs systems. A description is also given of how this research helps resolve unknown aspects of the areas investigated.

21386 (CONF-800301—6) **Calculation of electric field-induced detachment rate of electrons from mononegative ions; relevance to gaseous dielectrics.** Schweinler, H.C.; Christophorou, L.G. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA). Dept. of Physics). 1980. Contract W-7405-ENG-26. 12p. Dep. NTIS, PC A02/MF A01.

From 2. international symposium on gaseous dielectrics; Knoxville, TN, USA (9 Mar 1980).

This model for the mononegative atomic or molecular ion in its effect on the most loosely bound electron is a spherical square well (constant positive inner potential within a sphere of radius r_0 and zero potential outside). From it we have calculated by quantum mechanics the emission rate w/sub vlm/ of electrons from the v/sup th/ excited state (of orbital angular momentum and magnetic quantum numbers l and m and energy E/sub vl/ < 0) under the influence of a constant electric field F. The calculation is conceptionally simple (involving time-dependent perturbation theory) but technically complicated (requiring an eleven-fold integration), and leads to a surprisingly simple final expression. The relevance of our calculations to gaseous dielectrics is discussed.

21387 (COO—10514-2) **Electron transfer in ion-atom collisions.** Lin, C.D. (Kansas State Univ., Manhattan (USA). Dept. of Physics). 1979. Contract AC02-79ER10514. 8p. (CONF-790950—3). Dep. NTIS, PC A02/MF A01.

From International seminar on ion-atom collisions (ISIAC VI); Tokai-mura, Japan (6 Sep 1979).

Recent theoretical development in the understanding of electron transfer processes is reviewed. K-K electron transfer processes are studied for projectiles (nuclear charge Z/sub B/) and targets (nuclear charge Z/sub A/) in which Z/sub A/ and Z/sub B/ range from Z/sub A/ much greater than Z/sub B/ to Z/sub A/ ≈ Z/sub B/, over the energy range 0.1 < v/v/sub e/ < 2. (GHT)

21388 (LA—8267-MS) **Electron excitation collision strengths for positive atomic ions: a collection of theoretical data.** Merts, A.L.; Mann, J.B.; Robb, W.D.; Magee, N.H. Jr. (Los Alamos Scientific Lab., NM (USA)). Mar 1980. Contract W-7405-ENG-36. 227p. Dep. NTIS, PC A07/MF A01.

This report contains data on theoretical and experimental cross sections for electron impact excitation of positive atomic ions. It is an updated and corrected version of a preliminary manuscript which was used during an Atomic Data Workshop on Electron Excitation of Ions held at Los Alamos in November 1978. The current status of quantitative knowledge of collisional excitation collision strengths is shown for highly stripped ions where configuration mixing, relativistic and resonance effects may be important. The results show a reasonably satisfactory state for first-row isoelectronic ions and indicate that a considerable amount of work remains to be done for second-row and heavier ions.

21389 (LA-UR—80-922) **Characterization of multiple-photon absorption and dissociation of polyatomic molecules.** Judd, O.P. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 27p. (CONF-800432—1). Dep. NTIS, PC A03/MF A01.

From 2. international conference on multiphoton processes; Budapest, Hungary (14 Apr 1980).

A quantitative comparison of multiple-photon absorption (MPA) and dissociation (MPD) has been performed for experiments with a number of different polyatomic molecules. Appropriate normalization techniques for the absorption and dissociation parameters are formulated to account for the different conditions of the experiment and the molecular parameters. This procedure in a first approximation, accounts for the effects of independent variables such as gas pressure, optical bandwidth, optical pulse duration, excitation frequency, spectral width of the optical absorption band, absorption strength of the transition, bond strength, and the density of states in the molecule. The theoretical description of the dynamics of the absorbing ground state is considered and used to provide the rationale for the normalization procedure. The results of this analysis indicate that the functional dependence of the number of photons absorbed per molecule with fluence is qualitatively the same for the most molecules. Similarly, the probability for dissociation of most molecules can be related to the density of vibrational states, the bond strength, the number of photons absorbed per molecule, and the width of the absorbing transition. The functional relationships derived for MPA and MPD can be related to several theoretical aspects of the optical interaction process. In particular, the implications for the basic absorption mechanisms and the distribution of vibrational energy in the molecule will be addressed.

21390 (SAND—79-2385C) **Sputter yield determination for binary alloys.** Nelson, G.C. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 14p. (CONF-800442—1). Dep. NTIS, PC A04/MF A01.

From Symposium on sputtering; Vienna, Austria (28 Apr 1980).

Desorption cross sections and sputter yields for a 10 at% Pt to 90 at% Rh alloy have been measured for He^3 and Ne^{20} ions in the energy range of 500 eV to 5000 eV. The energy dependence and magnitude of the sputter yields are consistent with what is predicted for the bulk material.

ATOMIC AND MOLECULAR THEORY

REFER ALSO TO CITATION(S) 21386

21391 (ANL-Trans—1187) **Speed of sound and compressibility of inorganic acid aqueous solutions.** Mikhailov, I.G.; Shutilov, V.A. Translated from *Vestn. Leningr. Univ., Ser. Fiz. Khim.;* No. 16, 16-28(1956). 18p. Dep. NTIS, PC A02/MF A01.

To determine the influence on solutions, the velocity of sound was measured in inorganic acid solutions of HCl, HNO_3, and H_2SO_4 within a broad range of concentrations and in a temperature range of 15° to 95°C. The results are presented. (GHT)

GENERAL FLUID DYNAMICS

21392 (UCRL—83925) **FEM solution of the Navier-Stokes equations for vortex shedding behind a cylinder: experiments with the four-node element.** Gresho, P.M.; Lee, R.L.; Upson, C.D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jan 1980. Contract W-7405-ENG-48. 18p. (CONF-800515—2). Dep. NTIS, PC A02/MF A01.

From 3. international conference on finite elements in water resources; Oxford, MS, USA (19 May 1980).

Results from three variations on a simple 4-node element (bilinear velocity and piecewise constant pressure) are compared with those from a higher order element (9-node biquadratic velocity and 4-node bilinear pressure) on the same problem and on the same grid. (GHT)

21393 **Some properties of curved shock waves in ideal fluid mixtures with multiple temperatures.** Bowen, R.M. (Rice Univ., Houston, TX); Chen, P.J. *Acta Mech.;* 33: 265-280(1979).

The theory of singular surfaces is used to investigate the properties of curved shock waves propagating in a mixture where the combined effects of diffusion and multiple temperatures are present. It is shown how diffusion in front of the shock will cause, even for plane shocks, a spin jump across the shock. The analysis contains formulas which govern the evolutionary properties of the shock strength. These formulas show how the curvature, motion in front of the shock, diffusion, and energy supplies influence the shock strength.

PROPERTIES AND STRUCTURE OF FLUIDS

REFER ALSO TO CITATION(S) 20886

SUPERFLUIDITY

21394 Structue transition in hydrogen below 1°K. Gates, J.V.; Ganfors, P.R.; Fraass, B.A.; Simmons, R.O. (Univ. of Illinois, Urbana). Contract DOE-76-C-02-1198. *J. Phys. (Paris), Colloq.;* **39**: No. 8, C6103-C6106(1978).

The cfc to hcp and hcp to cfc phase transition in single crystals of hydrogen have been studied using x-ray diffraction techniques. The transition temperature, T*, is mapped as a function of orthohydrogen concentration, x, in the region of $0.13\ K < T < 1.5\ K$ and $0.48 < X < 0.7$.

PARTICLE INTERACTIONS AND PROPERTIES - EXPERIMENTAL

21395 Experimental summary of the XIII Rencontre de Moriond. Perl, M.L. (Stanford Linear Accelerator Center, CA (USA)). pp 515-563 of Gauge theories and leptons. Vol. 2. Tran Thanh Van, J. (ed.). Gif-sur-Yvette, France (B.P. 44); Editions Frontieres (1978).

Results are reviewed in the following areas: studies of the quark-parton model, Bjorken scaling, and quark fragmentation using virtual photons, neutrinos, and e^+-e^- annihilation; properties of the tau lepton, D charmed meson, and F charmed meson as measured in e^+-e^- annihilation; production of charmed particles by photons, neutrinos, and hadrons, including the CERN beam dump experiments; and ongoing searches for new particles.

WEAK INTERACTIONS

21396 (LBL—10428) Results on charmed baryons and mesons from the SLAC-LBL Mark II detector at SPEAR. Goldhaber, G. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1979. Contract W-7405-ENG-48. 30p. (CONF-7910103—5). Dep. NTIS, PC A03/MF A01.

From Workshop on the production of new particles in super high energy collisions; Madison, WI, USA (22 Oct 1979).

Results from the SLAC-LBL Mark II detector at SPEAR are presented. A few of the very recent results are emphasized, namely: (1) The observation of charmed baryons; a signal $\Lambda/sub\ c/ \rightarrow pK^-\pi^+$ and the charge conjugate of that channel, anti $\Lambda/sub\ c/ \rightarrow$ anti $pK^+\pi^-$ are now established. Some evidence also exists for other channels, K/sub S/p, $\Lambda\pi^+$, etc. (2) The study of charmed mesons. Here some new hadronic decay modes are mentioned, and the Cabibbo-suppressed decay modes. (3) The D^+ - D^0 lifetime ratio; evidence is presented that the D^+ has a longer lifetime than the D^0 by about a factor of three, although the statistical error is fairly large on this number.

21397 Observation of tetralepton ($\mu^+ e^+ e^- e^-$) production. Lubatti, H.J. (Washington Univ., Seattle (USA). Dept. of Physics). pp 267-275 of Gauge theories and leptons. Vol. 2. Tran Thanh Van, J. (ed.). Gif-sur-Yvette, France (B.P. 44); Editions Frontieres (1978).

The observation of the production of two electrons, one positron, one positively-charged muon, a neutral K meson, and seven gammas in neutrino interactions in the Fermilab 15-foot bubble chamber is reported.

21398 Lepton and charm production in the 15 foot FNAL bubble chamber. Palmer, R.B.; Cnops, A.M.; Connolly, S.A. (Brookhaven National Lab., Upton, NY (USA)). pp 361-380 of Gauge theories and leptons. Vol. 2. Tran Thanh Van, J. (ed.). Gif-sur-Yvette, France (B.P. 44); Editions Frontieres (1978).

The report is on ν interactions in the FNAL 15 foot bubble chamber filled with heavy neon. Inclusive production of π^+, π^-, K^0 and Λ^0 is shown. Limits are given on the production and hadronic decay of $\Lambda/sub\ c/$. The rate of D^0 production and decay to $K^0\pi^+\pi^-$ is reported. Events containing a μ^- and e^+ are observed and interpreted as leptonic decay of charm. Events with single e^+ or e^- are reported and found to be consistent with anti-ν(e) and ν(e) interactions.

STRONG BARYON-INDUCED INTERACTIONS

21399 (COO—3064-041) Search for prompt neutrinos and new penetrating particles from 28 GeV proton-nucleus collisions. Soukas, A.; Wanderer, P.; Weng, W. (Brookhaven National Lab., Upton, NY (USA); Harvard Univ., Cambridge, MA (USA); Oak Ridge National Lab., TN (USA); Pennsylvania Univ., Philadelphia (USA)). 1979. Contract EY-76-C-02-3064. 13p. Dep. NTIS, PC A02/MF A01.

A search for weak or semi-strongly interacting particles produced in the collision of 4.9×10^{18} 28-GeV protons with a thick copper and brass beam stop is described. 104 events were observed. Their characteristics are similar to those produced by neutrinos arising from proton interactions in a 15-cm-thick brass target. However, compared to the number expected, an excess of 48 events is found with uncertainities of +-10 (statistical) and +-12 (systematic). At most 6 events (68% C.L.) are attributable to beam losses.

STRONG MESON-INDUCED INTERACTIONS

21400 Fermilab results on lepton pair production. Pilcher, J.E. (Chicago Univ., IL (USA). Enrico Fermi Inst.). pp 65-81 of Phenomenology of quantum chromodynamics. Vol. 1. Tran Thanh Van, J. (ed.). Gif-sur-Yvette, France (B.P. 44); Editions Frontieres (1978).

Recent results are presented for pion-induced μ-pairs with masses above 4 GeV. The data show many of the general features predicted by the Drell-Yan quark-antiquark annihilation model. The P/sub T/ dependence of the data is discussed and compared with that for proton-induced pairs at a similar incident energy. The Feynman-X dependence of antiproton-induced J/PSI is presented and found to be similar to p-induced events.

PARTICLE INTERACTIONS AND PROPERTIES - THEORETICAL

ELECTROMAGNETIC INTERACTIONS

REFER ALSO TO CITATION(S) 21405, 21408

21401 (CONF-780876—6) **Calculation of meson radii in the geometrical model.** Chou, T.T. (Georgia Univ., Athens (USA)). 1978. Contract EY-76-S-09-0946. 8p. Dep. NTIS, PC A02/MF A01.

From Meeting on frontier of physics; Singapore, Japan (14 Aug 1978).

The radii of the pions and the kaons are computed with the geometrical model of hadron-hadron collisions using the recently published meson-proton scattering data at 200 GeV. Estimated errors are also given.

21402 Fundamental length hypothesis in a gauge theory context. Kadyshevsky, V.G. (Fermi National Accelerator Lab., Batavia, IL (USA)). pp 114-124 of Group theoretical methods in physics. Proceedings. Beiglboeck, W.; Boehm, A.; Takasugi, E. (eds.). Berlin, Germany, F.R.; Springer (1979).

From Colloquium on group theoretical methods in physics; Austin, TX, USA (11 Sep 1978).

The new gauge formulation of the electromagnetic interaction theory, containing the 'fundamental length' l as a universal scale like $h/2\pi$ and c, is worked out. A key part belongs to the 4-dimensional de Sitter p-space, with the curvature radius $h(2\pi lc)$. In the new approach the electromagnetic potential becomes a 5-vector associated with de Sitter group O(4.1). The extra fifth component, called the tau-photon, similar to scalar and longitudinal photons, does not correspond to an independent dynamical degree of freedom. Respectively, the new local gauge group is larger than the ordinary one and depends intrinsically on the fundamental length l. The gauge invariant equations of motion, replacing the Dirac-Maxwell equations, are set up. The new formulation is minimal with respect to the 5-potential but is not so in terms of the usual 4-potential. As a result, the underlying physics looks much richer than the ordinary electromagnetic phenomena. The new scheme predicts the existence of the electric dipole moments for charged particles, leading to a direct violation of P- and CP-symmetries, and the new universal correction to the (g-2)-anomaly. Further, some new group of internal symmetry, SU/sub tau/(2), arises that can be used to describe the μe-symmetry of the electromagnetic interactions. It turns out that SU/sub tau/(2)-symmetry is violated by the 4-fermion type interaction, induced by tau-photons, with associated coupling constant. This novel interaction might give rise to the μe-mass difference and processes like $\mu \rightarrow 3e$, $\mu \rightarrow e\gamma$, etc. In the limit $l \rightarrow 0$, the new field equations turn into the Dirac-Maxwell equations for the electron, muon and electromagnetic fields. So, one may consider this approach as a generalization in a profound way of the standard theory of electromagnetic interactions at small distances $<= l$ (high energies $>= 1/l$). The upper bound for the fundamental length l is discussed with the various experimental data taken into account.

21403 Simple broken-symmetry treatment of the ground and radially excited state mesons and the $\Delta^+ \rightarrow P\gamma$ decay. Slaughter, M.D. (Los Alamos Scientific Lab., NM (USA). Theoretical Div.). pp 346-348 of Group theoretical methods in physics. Proceedings. Beiglboeck, W.; Boehm, A.; Takasugi, E. (eds.). Berlin, Germany, F.R.; Springer (1979).

From Colloquium on group theoretical methods in physics; Austin, TX, USA (11 Sep 1978).

In this article, I wish to consider the ground state and radially excited state pseudoscalar and vector mesons and also the $\Delta^+ \rightarrow P\gamma$ decay in the context of a simple algebraic model which is of a non-perturbative form. The model makes use of the well-known Gell-Mann SU(N) X SU(N) (N=2 or 4 in this article) algebras, assumed to be valid in broken symmetry. In addition, the dynamical concepts

of algebraic (level) realization and asymptotic SU(N) are introduced and utilized in the infinite momentum frame limit. Special attention is given to deriving a number of mass-mixing angle constraints involving the 0^{-+} and the 1^{--} mesons in the ground state and radially excited states and to relating the form factors G*/sub M/ and G*/sub E/ which describe the $\Delta^+ \rightarrow P\gamma$ decay to g /sub A(0)/(the nucleon axial-vector coupling constant) and k/sub p/ and k/sub N/ (the proton and neutron anomalous magnetic moments).

WEAK INTERACTIONS

21404 (SLAC-PUB—2428) **Lepton nucleon scattering.** Atwood, W.B. (Stanford Linear Accelerator Center, CA (USA)). Nov 1979. Contract EY-76-C-03-0515. 114p. Dep. NTIS, PC A06/MF A01.

The topic of lepton-nucleon inclusive scattering is reviewed. Some of the experiments providing data on these interactions are described first. Then the constituent model of the nucleon and the contribution of various types of experiments are discussed; data from the experiments are compared and some simple predictions of the quark model are covered. Next, some of the fundamental notions behind quantum chromodynamics (QCD) are presented. Subsequent sections examine detailed tests of QCD. These include the ratio of longitudinal to transverse photoabsorption cross sections, the proton form factor in elastic ep scattering, and the dependence of structure functions on Q^2. In conclusion, all the tests of QCD are tabulated, and the results are evaluated. 32 references, 33 figures, 4 tables. (RWR)

21405 **Unified yes, renormalized maybe.** Bludman, S.A. (Univ. of Pennsylvania, Philadelphia). *Nature (London);* **282**: No. 5736, 280-281(15 Nov 1979).

Whether or not weak vector mesons exist, current experiments confirm the existence of an effective Lagrangian containing a weak neutral current with the one parameter $\sin^2\theta$/sub w/. This letter shows that this result already establishes some unification of electron and weak interactions, so that the question is no longer whether unification is really true, but rather whether the theory is $SU_2 \times U_1$ symmetric and renormalizable. It also shows that, although weak charged currents must show structure below 160 GeV, the weak neutral currents can be structureless, that is m/sub z/ $= \infty$ is compatible with the observed current.

21406 **Baryon semileptonic decays-spectrum generating SU(3) and the Cabibbo Model.** Garcia, A. (Universidad Nacional Autonoma de Mexico, Mexico City. Departamento de Fisica). pp 311-316 of Group theoretical methods in physics. Proceedings. Beiglboeck, W.; Boehm, A.; Takasugi, E. (eds.). Berlin, Germany, F.R.; Springer (1979).

From Colloquium on group theoretical methods in physics; Austin, TX, USA (11 Sep 1978).

Baryon semileptonic decays, in which a hyperon α decays into another one α' and a charged lepton-neutrino pair, $\alpha \rightarrow \alpha' + l + \nu$, provide an excellent testing ground for strong interaction symmetries like SU(2) and SU(3). Our present approach to these decays consists of V-A theory, which provides a rather general framework, and of the requirement of basic symmetry properties of the hadronic part of the transition amplitude. We briefly review all of this, introducing the Cabibbo Model and the Spectrum Generating SU(3) formulation. We also discuss some important questions concerning the experimental information and point out what we think is the best way to use it.

STRONG INTERACTIONS, GENERAL

21407 (DOE/ER/00946—3) **High energy hadron-hadron collisions. Annual progress report for 1979.** Chou, T.T. (Georgia Univ., Athens (USA). Dept. of Physics). Mar 1980. Contract EY-76-S-09-0946. 15p. Dep. NTIS, PC A02/MF A01.

Work on high-energy hadron-hadron collisions in the geometrical model, performed under the DOE Contract No. DE-AS09-76ER00946, is summarized. Specific items studied include the elastic hadron-hadron scattering at ultrahigh energies and the existence of many dips, the computation of meson radii, the hadronic matter current effects on inelastic two-body processes, and the diffraction dissociation processes in hadron-nucleus and hadron-hadron collisions. No data are included with this report; references are given.

21408 **How to build hadron multiplets from stable particles.** Barut, A.O. (Colorado Univ., Boulder (USA). Dept. of Physics). pp 490-498 of Group theoretical methods in physics. Proceedings. Beiglboeck, W.; Boehm, A.; Takasugi, E. (eds.). Berlin, Germany, F.R.; Springer (1979).

From Colloquium on group theoretical methods in physics; Austin, TX, USA (11 Sep 1978).

New realizations of SU(3)-hadron multiplets are given in terms of stable particles, proton, electron, neutrino, and μ-meson, considered as a magnetically excited state of electron. Magnetic interactions between these particles can produce pairings of leptons and further coupling of these pairs with the proton. A shift of 2/3 of the leptonic charge to the electric charge relates leptons to quarks. Internal quantum numbers of hadrons and many rules of hadron interactions acquire simple physical interpretations.

21409 **Geometrically formulated gauge dynamics for extended hadrons.** Drechsler, W. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.)). pp 98-113 of Group theoretical methods in physics. Proceedings. Beiglboeck, W.; Boehm, A.; Takasugi, E. (eds.). Berlin, Germany, F.R.; Springer (1979).

From Colloquium on group theoretical methods in physics; Austin, TX, USA (11 Sep 1978).

A de Sitter gauge invariant set of field equations is investigated as a possible basis for a gauge description of extended hadrons. The formalism uses an underlying geometric structure given by a fiber bundle over space-time with Cartan connection possessing as fiber a 4-dimensional space of constant curvature characterized by a curvature radius R chosen to be of the order of a Fermi. The constant R represents an elementary length parameter of geometric origin associated with strong interaction physics. A curvature is induced on the bundle space through a hadronic matter distribution described by a generalized bilocal wave field PSI(x,xi) where x denotes a point in the base space (space-time) and xi varies in the local fiber. An expansion of the internal motion associated with the varible xi is given in terms of 'de Sitter plane waves', i.e. the so-called horospherical waves, which are the analogue of the usual plane waves in flat Minkowski space-time. In this context the harmonic analysis of scalar and spinor fields in (4,1) de Sitter space is discussed and its relevance to the SO(4,1) gauge theory is pointed out.

STRONG INTERACTIONS, BARYON NO.=0

REFER ALSO TO CITATION(S) 21403, 21433

21410 **Structure of the multiquark meson states.** Bose, S.K. (Notre Dame Univ., IN (USA). Dept. of Physics). pp 499-507 of Group theoretical methods in physics. Proceedings. Beiglboeck, W.; Boehm, A.; Takasugi, E. (eds.). Berlin, Germany, F.R.; Springer (1979).

From Colloquium on group theoretical methods in physics; Austin, TX, USA (11 Sep 1978).

After a short survey of the nonet model the author describes an analogous model for multiquark meson states. He shows that the corresponding symmetry group has a class of representations, which are called completely degenerated representations. Mass-splittings within these representations are discussed.

STRONG INTERACTIONS, BARYON NO.=1

REFER ALSO TO CITATION(S) 21406

APPLICATIONS TO ELECTROMAGNETIC AND WEAK INTERACTIONS

REFER ALSO TO CITATION(S) 21402, 21403

APPLICATIONS TO STRONG INTERACTIONS

REFER ALSO TO CITATION(S) 21433

FIELD THEORY

REFER ALSO TO CITATION(S) 21404, 21408, 21409, 21433

21411 **Solitons.** Campbell, D. (Los Alamos Scientific Lab., NM (USA). Theoretical Div.). pp 7-15 of Group theoretical methods in physics. Beiglboeck, W.; Boehm, A.; Takasugi, E. (eds.). Berlin, Germany, F.R.; Springer (1979).

From Colloquium on group theoretical methods in physics; Austin, TX, USA (11 Sep 1978).

The author gives an introduction of solitons starting from nonlinear, dispersive wave equations. He discusses relations of solitons to the theory of non-Abelian gauge groups.

21412 **Nuclear physics in one dimension.** Campbell, D.K. (Los Alamos Scientific Lab., NM (USA)). pp 673-716 of Nuclear physics with heavy ions and mesons. Vol. II. Balian, R.; Rho, M.; Ripka, G. (eds.). Amsterdam, Netherlands; North-Holland (1978).

From Conference on nuclear physics with heavy ions and mesons; Les Houches, France (7 Jul 1977).

The author discusses the so-called sigma model quantum field theory in two - that is, one space and one time - dimensions.

PHYSICS RESEARCH

NUCLEAR PHYSICS

REFER ALSO TO CITATION(S) 20640

21413 (BNL-NCS—51123) **Standard reference and other important nuclear data by the Cross Section Evaluation Working Group.** (Brookhaven National Lab., Upton, NY (USA)). Dec 1979. Contract EY-76-C-02-0016. 145p. (ENDF—300). Dep. NTIS, PC A07/MF A01.

This report is a current review of the status of standard reference and other important nuclear data pointing out data discrepancies, recommending new measurements, and comparing the current version of ENDF/B with data. Neutron reactions with ^{1}H, ^{3}H, ^{6}Li, ^{10}B, ^{12}C, ^{59}Co, ^{80}Kr, ^{136}Xe, ^{153}Eu, and ^{197}Au are included, along with reaction and other data for the actinide nuclei. Cross sections, spectra, etc., are given for some of the nuclides considered. (RWR)

21414 (CONF-791058—70) **Evaluated data collections from ENSDF.** Ewbank, W.B. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 3p. Dep. NTIS, PC A03/MF A01.

From International conference on nuclear cross sections for technology; Knoxville, TN, USA (22 Oct 1979).

For several years the Nuclear Data Project has been maintaining an Evaluated Nuclear Structure Data File (ENSDF), which is designed to include critically evaluated values for most nuclear spectroscopic quantities. The information in ENSDF is the same as in the Nuclear Data Sheets, which illustrates two particular output formats (drawings and tables). Spectroscopic information for nuclei with A < 45 is put into ENSDF from the evaluations of Aizenberg-Selove and of Endt and van der Leun. An international network was organized to provide regular revisions of the data file. Computer facilities were developed to retrieve collections of evaluated data for special calculations or detailed examination.

21415 (COO—3246-19) **Nuclear research with heavy ions. Annual progress report, January 1, 1979-December 31, 1979.** Kaplan, M. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Chemistry). Oct 1979. Contract EY-76-S-02-3246. 79p. Dep. NTIS, PC A05/MF A01.

The experimental research emphasizes the detection and measurement of light charged particles emitted in reactions between heavy ions and complex nuclei. The program involves a collaboration between Carnegie-Mellon University and SUNY at Stony Brook, and utilizes the SuperHILAC and 88" cyclotron accelerator facilities of the Lawrence Berkeley Laboratory. Correlations between light charged particles and heavy fragments provide detailed insights into the dynamics of the reaction mechanism. The light charged particles evaporated from fully accelerated fragments yield information on the excitation energies and spins of the equilibrated reaction products, whereas those particles that are emitted prior to thermal equilibration give a view of the early stages of the reaction. Experimental results of fusion and charged particle emission cross sections are discussed for a variety of heavy ion reactions, particularly those induced by ^{40}Ar ions. The theoretical development of the statistical model as applied to particle evaporation is reviewed, and semiempirical methods for facilitating comparisons with experimental data are presented. Current results from singles and coincidence experiments are given in detail for reactions of 340-MeV ^{40}Ar with Au, and analyses of average spins and energy sharing among particles are discussed.

21416 (IAEA-NDS—11) **ENDF-1978. LLL evaluated Nuclear Data Library 1978. Contents and documentation.** (International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section). Jul 1979. 6p. Dep. NTIS (US Sales Only), PC A02/MF A01.

The contents and documentation of the 1978 version of the Evaluated Nuclear Data Library of the Lawrence Livermore Laboratory, USA are summarized. The Library contains numerical neutron reaction data for 88 isotopes or elements.

21417 (LA—8157-PR) **Applied nuclear data research and development. Progress report, July 1-September 30, 1979.** Baxman, C.I.; Young, P.G. (comps.). (Los Alamos Scientific Lab., NM (USA)). Nov 1979. Contract W-7405-ENG-36. 27p. Dep. NTIS, PC A03/MF A01.

This report describes the activities of the Los Alamos Nuclear Data Group for the period July 1 through September 30, 1979. Research is summarized for the following three subject areas: theory and evaluation of nuclear cross sections; nuclear cross section processing; and fission product and actinides (yields, decay data, depletion, and buildup). Three of the items in this report were abstracted individually. 20 figures, 9 tables. (RWR)

NUCLEAR PROPERTIES AND REACTIONS, A=1-5, THEORETICAL

NUCLEAR REACTIONS AND SCATTERING

21418 (LA—8157-PR, pp 1-4) **R-matrix analysis of light systems.** Hale, G.M.; Dodder, D.C. Nov 1979.

In Applied nuclear data research and development. Progress report, July 1-September 30, 1979.

The n-T total cross section was predicted from 0 to 16 MeV from p-^{3}He parameters. Ratios of the integrated cross sections and the asymmetries for the two branches of the d + d reaction are shown; the effects of isospin mixing are noted. 2 figures. (RWR)

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 21436

NUCLEAR PROPERTIES AND REACTIONS, A=6-19, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 21419

NUCLEAR REACTIONS AND SCATTERING

21419 (DOE/ER/01388—439) **Unique determination of the amplitude and phase for the population of the giant dipole resonance in the $^{12}C(P,\gamma_0)^{13}N$ reaction.** Snover, K.A.; Ikossi, P.G.; Adelberger, E.G.; Lesko, K.T. (Washington Univ., Seattle (USA). Nuclear Physics Lab.). 1980. Contract EY-76-C-06-1388. 10p. Dep. NTIS, PC A02/MF A01.

The interference between the E/sub p/ = 14.23 MeV M1(E2) T = 3/2 resonance and the E1 giant dipole resonance background in the $^{12}C(P/sub\ pol/,\gamma_0)^{13}N$ reaction is used to determine uniquely the E1 reaction amplitudes. The E1 capture is found to be predominantly d-wave, in agreement with the basic shell-model description of the nuclear giant-dipole resonance. 3 figures.

21420 (DOE/ER/10423—T1) **Nuclear structure studies with pions and heavy ions. Progress report, June 1, 1979-May 31, 1980.** Dehnhard, D. (Minnesota Univ., Minneapolis (USA)). Mar 1980. Contract AC02-79ER10423. 54p. Dep. NTIS, PC A04/MF A01.

The elastic and inelastic scattering of π^+ and π^- by ^{13}C, ^{16}O, and ^{17}O was studied at pion energies close to the (3,3) resonance. Data were taken at the Los Alamos Meson Physics Facility. Large asymmetries were observed, two of which are consistent with pure neutron and pure proton excitations. Transitions to strongly excited states of ^{13}C are in strikingly good agreement with theoretical predictions of Lee and Kurath. In sharp contrast, strong disagreements are found for the weakly excited states. The asymmetries for $^{16}O + \pi^{+-}$ were interpreted as due to isospin mixing between the excited states. High-resolution data for (t,t') and (^{3}He,$^{3}He'$) on ^{12}C were taken to supplement the pion work. Asymmetries were found for the relative cross sections for some states. In studies of the heavy-ion-nucleus potential the effect of potential resonances on the elastic scattering of $^{16}O + ^{28}Si$ was found to be small. A close similarity between the elastic exchange amplitude at 180° and the effect of the parity dependence on the elastic amplitude was found. Fits to the new data at 40 and 41.226 MeV required the use of a composite absorptive potential. The surface derivative part of this potential can be deduced from a coupled-channels calculation. 17 figures.

NUCLEAR PROPERTIES AND REACTIONS, A=20-38, EXPERIMENTAL

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 21420

21421 (CONF-800329—2) **Distribution of products in the reaction ^{20}Ne + Al.** Ferguson, R.L.; Gavron, A.I.; Obenshain, F.E.; Plasil, F.; Robinson, R.L.; Shapira, D.; Snell, A.H.; Young, G.R. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 5p. Dep. NTIS, PC A02/MF A01.

From 1. workshop on nuclear dynamics; Tahoe City, CA, USA (17 Mar 1980).

The measurement and preliminary analysis of the distribution of products with Z between 2 and 21 and A between 3 and 43 from 118- and 167-MeV reactions of ^{20}Ne with Al are reported. Experimental conditions were adequate to allow resolution of individual isotopes over this entire range, and measurements were made at

several angles for each bombarding energy. Measured relative cross sections of the heavier products were compared with predictions of a statistical-model evaporation calculation. The overall agreement between experiment and theory was rather good; however, certain discrepancies between calculation and experiment for low Z and A at 167 MeV may be troublesome. 3 figures. (RWR)

21422 (DOE/ER/10420—1) **Fusion measurements in light and medium mass heavy-ion reactions. Progress report, June 1, 1979-May 31, 1980.** Prosser, F.W. (Kansas Univ., Lawrence (USA)). Jan 1980. Contract AC02-79ER10420. 11p. Dep. NTIS, PC A02/MF A01.

Data were obtained on the γ-ray yield from the fusion reactions of $^{16}O + {}^{24,26}Mg$ in the 25 to 70 MeV energy range. Analysis of these data in terms of the relative yields of specific residues as a function of bombarding energy is almost complete for $^{16}O + {}^{26}Mg$. Of particular interest will be a comparison of these results with those for $^{18}O + {}^{24}Mg$. The investigation of the fusion cross sections of $^{16}O + {}^{24,26}Mg$ was extended from 70 MeV to 140 MeV. An unexpected decrease in the fusion cross sections begins at about 100 MeV and persists to the highest energy obtained. This investigation will be continued to 170 MeV and expanded to include $^{18}O + {}^{24}Mg$. Data were obtained on the interaction of $^{16}O + {}^{40}Ca$ at 128 MeV to determine the reaction mechanisms, other than fusion, present at higher energy. Plans for continuation of these experiments and for new experiments are discussed. A major effort has been the development of new programing to take advantage of a new color graphics interactive terminal for data analysis. No data of significance are included with this report; completed work will be published. 2 figures. (RWR)

21423 (LA—8190-T) **Forward scattering amplitudes for π^{+-} on Al, Ca, Cu, Sn, Ho, and Pb in the energy range 114-215 MeV.** Jeppesen, R.H. (Los Alamos Scientific Lab., NM (USA)). Jan 1980. Contract W-7405-ENG-36. 209p. Dep. NTIS, PC A10/MF A01. Thesis.

Measurements have been made of the attenuation cross section, $\sigma(\Omega)$, for both π^+ and π^- projectiles on Al, ^{40}Ca, Cu, Sn, Ho, and Pb nuclei. The measurements were made over a range of energies including 114, 140, 165, and 215 MeV. A new method of analyzing transmission experiments data has been used to extract both the real and the imaginary parts of a forward scattering amplitude f/sub N/(0), where f/sub N/(0) is defined to be the limit as $\Omega \rightarrow 0$ of F(Ω)-f/sub c/(Ω). F(Ω) is the full elastic scattering amplitude and f/sub c/(Ω) is the relativistic point Coulomb amplitude. The values of f/sub N/(0) are compared with forward amplitudes from model calculation. These comparisons demonstrate that much of the observed rotation of the forward scattering amplitude, when plotted in the Argand plane, can be attributed to the Coulomb phase contained in the definition of f/sub N/(0). Results are also compared to those of other experiments. A difference is observed in attenuation measurements between this experiment and a Brookhaven experiment which measured total cross sections on Pb, Sn, and Al. There have been only a few published results in which experimental values of f/sub N/(0) are given. In those cases, general agreement is observed with the results of this experiment.

NUCLEAR PROPERTIES AND REACTIONS, A=39-58, THEORETICAL

NUCLEAR REACTIONS AND SCATTERING

21424 (LA—8157-PR, pp 4-8) **Evaluation of iron cross sections up to 40 MeV.** Arthur, E.D.; Young, P.G. Nov 1979.

In Applied nuclear data research and development. Progress report, July 1-September 30, 1979.

Neutron optical parameters for Fe are tabulated. Cross sections for neutron emission by direct and pre-equilibrium statistical processes induced by p and n on ^{56}Fe are shown, including excitation functions, angular distributions, and spectra. Integrated cross sections for p and α production by neutrons on both ^{54}Fe and ^{56}Fe are given. 8 figures, 1 table. (RWR)

NUCLEAR PROPERTIES AND REACTIONS, A=59-89, EXPERIMENTAL

REFER ALSO TO CITATION(S) 21423

RADIOACTIVE DECAY

REFER ALSO TO CITATION(S) 21425

ENERGY LEVELS AND TRANSITIONS

21425 (ANL—79-107) **Branching fraction in the radioactive decay of /sup 85m/Kr.** Jaffey, A.H.; Steinberg, E.P.; Gindler, J.E.; Gray, J. Jr.; Horwitz, E.P.; Hughes, J.P.; Schmitz, F.J. (Argonne National Lab., IL (USA)). Feb 1980. Contract W-31-109-ENG-38. 41p. Dep. NTIS, PC A03/MF A01.

The branching fraction in the decay of the fission product / sup 85m/Kr to the ground state ^{85}Kr (10.75 y) was measured relative to the total decay to both ^{85}Kr and ^{85}Rb. Samples of ^{235}U were highly irradiated in a high-flux reactor and dissolved. The ^{85}Rb was measured by isotope-dilution mass spectrometry, and the ^{85}Kr was counted in GM tubes the counting efficiencies of which were calibrated with a standardized ^{85}Kr gas of known disintegration rate. The branching fraction measured with both a low-burnup sample and a high-burnup sample was 0.2160 +- 0.0019, the largest error arising from the uncertainty in the caibration of the standardized gas. 1 figure, 9 tables.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 21423, 21447

21426 (COO—2439-6) **Measurement and analysis of neutron cross sections with the Oak Ridge Linear Accelerator neutron facility. Progress report, April 1, 1979-March 31, 1980.** Garg, J.B. (State Univ. of New York, Albany (USA). Dept. of Physics). Nov 1979. Contract EY-76-S-02-2439. 10p. Dep. NTIS, PC A02/MF A01.

This work involved the measurement, analysis, and interpretation of high-resolution neutron total and capture cross sections of many nuclei in the neutron energy range of few eV to few hundred keV. After a general overview of the program, the various experiments involved are described individually. These descriptions are of abstract length, and contain few data. (RWR)

NUCLEAR PROPERTIES AND REACTIONS, A=90-149, EXPERIMENTAL

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 21423, 21443

21427 (INDC(NDS)—103/M, pp 23-25) **Measurement of the activation cross section of the reaction $^{93}Nb(n,n')^{93m}Nb$ for 0-25 MeV neutrons.** Hegedues, F. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)); Guinan, M.W.; Meadows, J.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.); Peek, N.F. (California Univ., Davis (USA)); Greenwood, L.R. (Argonne National Lab., IL (USA)). May 1979.

In Proceedings of the advisory group meeting on nuclear data for reactor dosimetry, Vienna, 13-17 November 1978.

NUCLEAR PROPERTIES AND REACTIONS, A=150-189, THEORETICAL

NUCLEAR REACTIONS AND SCATTERING

21428 (CONF-800329—1) **Light-particle emission in reactions induced with carbon and oxygen ions.** Plasil, F.; Beene, J.R.; Ferguson, R.L. (Oak Ridge National Lab., TN (USA); Georgia State Univ., Atlanta (USA); Washington Univ., St. Louis, MO (USA); Vanderbilt Univ., Nashville, TN (USA)). 1980. Contract W-7405-ENG-26. 7p. Dep. NTIS, PC A02/MF A01.

From 1. workshop on nuclear dynamics; Tahoe City, CA, USA (17 Mar 1980).

Preliminary results are presented from three different experiments in which light particles emitted during the course of heavy-ion-induced reactions have been studied. The three experiments involved measurements of energies, angular correlations, and multiplicities of neutrons or alpha particles emitted in coincidence with deeply inelastic products or with evaporation residue produced as follows: (1) neutrons from reactions of ^{16}O with ^{93}Nb at 12.9 MeV/u; (2) alphas produced in the same system; and (3) neutrons produced in ^{12}C reactions with ^{158}Gd and in ^{13}C reactions with ^{157}Gd at about 12.4 MeV/u. (GHT)

NUCLEAR PROPERTIES AND REACTIONS, A=220 AND ABOVE, THEORETICAL

REFER ALSO TO CITATION(S) 21426

SPONTANEOUS AND INDUCED FISSION

21429 (LA—8157-PR, pp 12, 15) **Critical mass calculations for ^{242}Pu.** Kidman, R.B. Nov 1979.

In Applied nuclear data research and development. Progress report, July 1-September 30, 1979.

Critical masses for bare spheres were calculated from several data sets and compared with earlier results. The ONEDA code was used with S/sub n/ = 16, P/sub l/ = 3, and 50 mesh intervals. 1 table. (RWR)

NUCLEAR PROPERTIES AND REACTIONS, A=220 AND ABOVE, EXPERIMENTAL

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 21054

21430 **Neutron cross sections of thorium-232.** Chrien, R.E.; Liou, H.I.; Kenny, M.J.; Stelts, M.L. (Brookhaven National Lab., Upton, NY). *Nucl. Sci. Eng.*; **72**: No. 2, 202-215(Nov 1979).

The cross sections for neutron interactions with thorium targets were measured at several energies. Capture cross sections at 0.0253 eV and at 2 and 23.4 keV were measured by activation techniques. Transmission measurements were made from 10 to 100 eV, and capture cross sections were determined from 0.03 to 15 eV by recording discrete lines for the (n,γ) spectrum. The measured thermal cross section is 7.41 +- 0.08 b, at 2 keV the cross section is 1.96 +- 0.10 b, and at 24.3 keV it is 0.540 +- 0.014 b. These values are reported relative to an assumed ^{231}Pa branching ratio of 38.5% for the 311-keV gamma ray, and they do not include the branching ratio error. The results are fitted to R-matrix parameters. The transmission and (n,γ) measurements lead to parameters that give a somewhat higher epithermal capture than previously expected in thorium. This result brings the differential data into better agreement with experiments on subcritical assemblies.

SPONTANEOUS AND INDUCED FISSION

21431 **Simulated (n,f) cross sections for exotic actinide nuclei.** Britt, H.C.; Wilhelmy, J.B. (Los Alamos Scientific Lab., NM). *Nucl. Sci. Eng.*; **72**: No. 2, 222-229(Nov 1979).

Simulated (n,f) cross sections for E/sub n/ = 0.5 to 6 MeV are estimated from fission probabilities obtained in (^{3}He,df) and (^{3}He,tf) studies. Cross sections are presented for 34 isotopes of protactinium, uranium, neptunium, plutonium, americium, curium, berkelium, and einsteinium. Results are compared to direct (n,f) measurements for five cases.

NUCLEAR THEORY

21432 (LA-UR—80-723) **Time independent mean-field theory.** Negele, J.W. (Los Alamos Scientific Lab., NM (USA); Massachusetts Inst. of Tech., Cambridge (USA). Center for Theoretical Physics). Feb 1980. Contract W-7405-ENG-36. 52p. (CONF-800232—1). Dep. NTIS, PC A04/MF A01.

From International conference on extreme states in nuclear systems; Dresden, German Democratic Republic (4 Feb 1980).

The physical and theoretical motivations for the time-dependent mean-field theory are presented, and the successes and limitations of the time-dependent Hartree-Fock initial-vaue problem are reviewed. New theoretical developments are described in the treatment of two-body correlations and the formulation of a quantum mean-field theory of large-amplitude collective motion and tunneling decay. Finally, the mean-field theory is used to obtain new insights into the phenomenon of pion condensation in finite nuclei. 18 figures.

21433 **Field theory, chiral symmetry, and pion-nucleus interactions.** Campbell, D.K. (Los Alamos Scientific Lab., NM (USA)). pp 549-672 of Nuclear physics with heavy ions and mesons. Vol. II. Balian, R.; Rho, M.; Ripka, G. (eds.). Amsterdam, Netherlands; North-Holland (1978).

From Conference on nuclear physics with heavy ions and mesons; Les Houches, France (7 Jul 1977).

The pi meson plays special roles in nuclear and subnuclear physics. Most of these roles are related to the pion being by far the lightest of the 'hadrons', that is, those elementary particles having nuclear or strong interaction. From the perspective of nuclear physics, this small mass means that the pion controls the long range part of the nuclear force and thus influences strongly certain aspects of nuclear scattering and structure. In elementary particle physics the smallness of the pion mass is both a puzzle and a challenge: why a particle hardly more massive than the weakly-interacting μ-meson should have strong interactions; whether one can view the smallness of the parameter m/sub π//m/sub N/ as a possible clue to the structure of the interactions. The author propounds that such a point of view is indeed correct and that the smallness of the pion mass is a consequence of an approximate invariance of the strong interactions; 'chiral SU(2) X SU(2) symmetry'. Further, it is shown that this symmetry has other consequences - for example, the general weakness of low-energy pion interactions - which can provide important insight into the problem of pions in nuclei.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 21415

21434 (LBL—9595) **Heavy ion collisions.** Siemens, P.J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.; Niels Bohr Inst., Copenhagen (Denmark)). Dec 1979. Contract W-7405-ENG-48. 38p. (CONF-790847—17). Dep. NTIS, PC A03/MF A01.

From International conference on high energy physics and nuclear structure; Vancouver, Canada (13 Aug 1979).

The status of research into collisions of nuclei at high energy is reviewed. Reactions and products are classified, and spectator matter is discussed. Then the thermalization of participant matter is considered at some length. Finally, disintegration of the hot matter is addressed. A = 20 and 40 projectiles of 250 to 1050 MeV/A are employed to illustrate the major points. 44 references, 10 figures. (RWR)

NUCLEAR MODELS

21435 **Symmetries and statistical behavior in fermion systems.** French, J.B. (Rochester Univ., NY (USA). Dept. of Physics and Astronomy); Draayer, J.P. (Louisiana State Univ., Baton Rouge (USA). Dept. of Physics and Astronomy). pp 394-407 of Group theoretical methods in physics. Proceedings. Beiglboeck, W.; Boehm, A.; Takasugi, E. (eds.). Berlin, Germany, F.R.; Springer (1979).

From Colloquium on group theoretical methods in physics; Austin, TX, USA (11 Sep 1978).

The authors discuss the interplay between spectra and distributions for various kinds of nuclear excitations. They use information theoretical methods and the U(n) group.

21436 **SU_3 symmetry and integral kernels for nuclear cluster problems.** Hecht, K.T.; Zahn, W. (Michigan Univ., Ann Arbor (USA). Dept. of Physics). pp 408-419 of Group theoretical methods in physics. Proceedings. Beiglboeck, W.; Boehm, A.; Takasugi, E. (eds.). Berlin, Germany, F.R.; Springer (1979).

From Colloquium on group theoretical methods in physics; Austin, TX, USA (11 Sep 1978).

After an introduction of the nuclear cluster model the author discusses the Bargmann-Segal integral transformation used for the study of SU(3) coupling. As example he considers the ^{12}C nucleus and the norm problem for the (α + heavy fragment)-cluster system.

21437 **Recent work on collective motion.** Weaver, L. (Kansas State Univ., Manhattan (USA). Dept. of Physics). pp 430-437 of Group theoretical methods in physics. Proceedings. Beiglboeck, W.; Boehm, A.; Takasugi, E. (eds.). Berlin, Germany, F.R.; Springer (1979).

From Colloquium on group theoretical methods in physics; Austin, TX, USA (11 Sep 1978).

The author discusses the use of irreducible representations of SL(3,R) and its relatives for the description of collective excitations in nuclei. After a description of the algebra used for this reason, sum rules, spectra, transition rates, and Hamiltonians are discussed.

RADIATION AND SHIELDING PHYSICS

RADIATION PHYSICS

21438 (CONF-7810231—1) **Lecture 3: the methods and applications of discrete ordinates in low energy neutron-photon transport (ANISN, DOT). Part I. Methods.** Engle, W.W. Jr. (Oak Ridge National Lab., TN (USA)). 1978. Contract W-7405-ENG-26. 17p. Dep. NTIS, PC A02/MF A01.

From Computer techniques in shielding and dosimetry meeting; Erice, Sicily, Italy (25 Oct 1978).

A rather complete description of the derivation of the finite difference form of the transport equation can be found in earlier work; therefore that derivation is discussed here. Attention is focused on the additional equations required to solve the transport equation which are often referred to as flux models and on the iteration process and efforts to accelerate the convergence of the iteration process. All equations discussed here are limited to the one-dimensional, time-independent case, but they may be extended in a straightforward manner to multidimensional, time-dependent geometries.

21439 (LA—8232-PR) **X-6 activity report. Progress report, July-December 1979.** Soran, P. (comp.). (Los Alamos Scientific Lab., NM (USA)). Feb 1980. Contract W-7405-ENG-36. 86p. Dep. NTIS, PC A05/MF A01.

Research and development progress in Monte Carlo particle transport theory by the Los Alamos Scientific Laboratory's Group X-6 for the period ending 31 December 1979 is reported. Enclosed are tasks in the areas of MCNP code development, Monte Carlo theory and Monte Carlo cross sections.

21440 (SAND—79-0414) **Calorimetric measurement of electron energy deposition in extended media. Theory vs experiment.** Lockwood, G.J.; Ruggles, L.E.; Miller, G.H.; Halbleib, J.A. (Sandia Labs., Albuquerque, NM (USA)). Jan 1980. Contract EY-76-C-04-0789. 142p. Dep. NTIS, PC A07/MF A01.

A new calorimetric technique has been developed for measuring electron energy deposition profiles in one dimension. The experimental procedures and theoretical analyses required in the application of the new method are reviewed. Extensive results are presented for electron energy deposition profiles in semi-infinite homogeneous and multilayer configurations. These data cover a range of elements from beryllium through uranium at source energies from 0.3 to 1.0 MeV (selected data at 0.5 and 0.1 MeV) and at incident angles from 0^0 to 60^0. In every case, the experimental profiles are compared with the predictions of a coupled electron/photon Monte Carlo transport code. Overall agreement between theory and experiment is very good. However, there appears to be a tendency for the theoretical profiles to be higher near the peaks and lower near the tails, especially in high-Z materials. There is also a discrepancy between theory and experiment in low-Z materials near high-Z/low-Z interfaces.

21441 (UCRL—83457) **Local energy transfer to TLDS by neutrons and photons.** Singh, M.S.; Gaines, J.L.; Parlagreco, J.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Mar 1980. Contract W-7405-ENG-48. 10p. (CONF-800426—1). Dep. NTIS, PC A02/MF A01.

From 6. international conference on solid state dosimetry; Toulouse, France (1 Apr 1980).

The local energy transferred from neutrons and photons to TLD materials with respect to energy transferred to biological tissues or air has been calculated. Experimental response of TLDs was measured for photons with energies above 1.5 keV.

SHIELDING CALCULATIONS AND EXPERIMENTS

21442 (CONF-791103—96) **Overview of CSEWG shielding benchmark problems.** Maerker, R.E. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 6p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

The fundamental philosophy behind the choosing of CSEWG shielding benchmarks is that the accuracy of a certain range of cross section data be adequately tested. The benchmarks, therefore, consist of measurements and calculations of these measurements. Calculations for which there are no measurements provide little information on the adequacy of the data, although they can perhaps indicate the sensitivity of results to variations in data.

NEUTRON INTERACTIONS WITH MATTER

REFER ALSO TO CITATION(S) 21438

21443 (CONF-791223—6) **Recent capture cross section data from ORELA above 2.6 keV.** Macklin, R.L.; Winters, R.R.; Halperin, J. (Oak Ridge National Lab., TN (USA); Denison Univ., Granville, OH (USA)). 1979. Contract W-7405-ENG-26. 10p. Dep. NTIS, PC A02/MF A01.

From NEANDC specialist meeting on neutron cross sections of fission product nuclei; Bologna, Italy (12 Dec 1979).

Neutron capture by natural rhodium (^{103}Rh) and enriched stable isotopes of ruthenium (100 to 104) and palladium (104 to 110) were measured at the Oak Ridge Electron Linear Accelerator pulsed neutron facility. Average pure isotope cross sections from three to several hundred keV were derived. The neutron flux shape was determined relative to ENDF/B V standard ^{6}Li(n,α) and ^{235}U(n,f) cross sections below and above 70 keV respectively. Strength functions were adjusted to fit the data by least squares. The ^{101}Ru fission product would appear to cause less poisoning than ^{105}Pd or ^{103}Rh in plutonium fueled fast reactors.

21444 **Computer results on transport properties.** Alder, B.J. (California Univ., Livermore (USA)). pp 168-209 of Stochastic processes in nonequilibrium systems. Garrido, L.; Seglar, P.; Shepherd, P.J. (eds.). Berlin, Germany, F.R.; Springer (1978).

These lectures start with a broad discussion of generalized hydrodynamics, illustrating with three examples how useful this approach is in extending hydrodynamics to nearly the scale of molecular dimensions and the time between collisions, principally by including viscoelastic effects. The three examples concern the behaviour of the velocity autocorrelation function, the decay of fluctuations in a resonating system, and the calculation of the dynamic structure factor obtained from neutron scattering. For the latter, we also compare the results of molecular dynamics with the predictions of the generalized kinetic theory. Finally we point out the way to implement generalized hydrodynamics, both on a microscopic and on a macroscopic level. The last part is devoted to the Lorentz gas. We show how the longtime tail in the velocity autocorrelation functions and the divergent Burnett coefficients can be accounted for by a random walk. This predicts, in agreement with observations, the displacement distribution to be Gaussian at long times for the Lorentz gas, whereas for hard discs it has been found not to be the case.

21445 (LA-UR—80-35) **Calculation of neutron cross sections on iron up to 40 MeV.** Arthur, E.D.; Young, P.G. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 5p. (CONF-800607—2). Dep. NTIS, PC A02/MF A01.

From American Nuclear Society annual meeting; Las Vegas, NV, USA (8 Jun 1980).

The development of high energy d + Li neutron sources for fusion materials radiation damage studies will require neutron cross sections up to 40 MeV. Experimental data above 15 MeV are generally sparse or nonexistent, and reliance must be placed upon nuclear-model calculations to produce the needed cross sections. To satisfy such requirements for the Fusion Materials Irradiation Test Facility (FMIT), neutron cross sections have been calculated for ^{54} ^{56}Fe between 3 and 40 MeV. These results were joined to the existing ENDF/B-V evaluation below 3 MeV. In this energy range, most neutron reactions can be described using the Hauser-Feshbach statistical model with corrections for preequilibrium and direct-reaction effects. To properly use these models to obtain realistic cross sections, emphasis must be placed upon the determination of suitable input parameters (optical model sets, gamma-ray strength functions, level densities) valid over the energy range of the calculation. To do this, several types of independent data were used to arrive at consistent parameter sets as described.

21446 **Integral tests of neutron activation cross sections in a ^{9}Be(d,n) field at E/sub d/ = 40 MeV.** Greenwood, L.R. (Argonne National Lab., IL); Heinrich, R.R.; Saltmarsh, M.J.; Fulmer, C.B. *Nucl. Sci. Eng.*; **72**: No. 2, 174-190(Nov 1979).

Neutron activation measurements are reported for 44 reactions from 14 materials irradiated in a well-characterized neutron field produced by 40-MeV deuterons impinging on ^{9}Be at the Oak Ridge Isochronous Cyclotron. Foil packets were located at 0 to 15 deg to the beam at 7.62 cm from the source, and additional foil materials were located directly on the deuteron beam stop 6.25 mm from the source. Integral tests were made for 30 reactions using previously measured time-of-flight (TOF) spectra and neutron cross sections, primarily from ENDF/B-IV, extrapolated to 44 MeV. The integral results are excellent, with an overall standard deviation of +- 11% for 25 recommended reactions (+- 14% for 30 reactions), and neutron spectra unfolded with the SAND II code show excellent agreement with TOF measurements.

21447 **Gamma-ray production and inferred inelastic neutron cross sections for nickel isotopes.** Traiforos, S.; Mittler, A.; Schier, W.A.; Barnes, B.K.; Beghian, L.E.; Harihar, P. (Univ. of Lowell, MA). *Nucl. Sci. Eng.*; **72**: No. 2, 191-201(Nov 1979).

A total of 22 gamma-ray transitions were measured from (n,n'γ) reactions on the four even-even nickel isotopes, /sup 58,60,62,64/Ni. Absolute gamma-ray production excitation functions at 125 deg were extracted for these transitions from their thresholds up to neutron energies of 4 MeV. Inelastic neutron scattering cross sections for 19 levels were inferred from the gamma-ray production data and compared to the Evaluated Nuclear Data File (ENDF/B-IV, MAT 1190). Cross-section agreement for the first excited 2^+ states in these four isotopes is generally good, but excitation functions associated with many of the higher excited states in nickel are in strong disagreement with the file.

MEDICAL PHYSICS

RADIATION PROTECTION STANDARDS

21448 (CONF-800427—1) **Updating the tritium quality factor: the argument for conservatism.** Till, J.E.; Etnier, E.L.; Meyer, H.R. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 5p. Dep. NTIS, PC A02/MF A01.

From Tritium technology in fission, fusion, and isotopic application; Dayton, OH, USA (29 Apr 1980).

Estimated doses resulting from tritium releases to the environment are linearly dependent upon the quality factor (Q) chosen for tritium beta radiation. In 1969 the International Commission on Radiological Protection (ICRP) recommended using 1 as the Q for all low energy beta radiation. Considerable improvements have been made in evaluating exposures to tritium at very low dose rates and in

refining physiological and biological endpoints since the 1969 ICRP recommendations. This study summarizes recent experiments to determine the relative biological effectiveness of tritium. Based upon our study of published data related to quality factor, its importance in the calculation of dose, and the currently accepted conservative philosophy in radiation protection, it is concluded that a value of 2 would seem to be more defensible for environmental assessments and that a reevaluation of the tritium quality factor by the ICRP is needed.

21449 (RFP-Trans—279) **Lead glass for x-ray protection.** Tahara, M. (ed.). 1 Feb 1977. Translation of JIS R 3701-1977. 9p. Dep. NTIS, PC A02/MF A01.

A radiation protection standard is presented for lead glass used in Japan. (GHT)

DOSIMETRY

21450 Relationship of external radiation doses to internal dosimetry. Bigler, R.E. Contract E(11-1)-3521. pp 17-31 of Therapy in nuclear medicine. Spencer, R.P. (ed.). New York, NY; Grune and Stratton, Inc. (1978).

It has long been recognized, especially in the area of external fractionated radiotherapy, that differing radiation dose, time, and fractionation patterns influence the effect of radiation on normal tissues. The nominal standard dose (NSD) concept was introduced to provide radiotherapists with a method for planning treatments utilizing a variety of radiotherapy delivery patterns which result in equal biological effects on normal tissues. This concept has been extended to implant brachytherapy and to nuclear medicine therapy with internally deposited radionuclides and labeled compounds. This chapter presents computational procedures needed to evaluate the effects of treatments by the three therapy methods either alone or in combination, and the results of calculations using these procedures to estimate the hazard to marrow associated with the internal use of ^{131}I and ^{125}I-sodium iodide; ^{32}P and ^{33}P-EHDP; and ^{35}S-sulfate. The theory of Douglas and Fowler is shown by a procedure suggested by them to be consistent with the empirical normalization used to quantitatively compare the effects of fractionated and continuous radiotherapy.

SOLID STATE PHYSICS

21451 (DOE/ER/10459—1) **Intersubband-cyclotron combined resonance in a surface space-charge layer.** O'Connell, R.F. (Louisiana State Univ., Baton Rouge (USA). Dept. of Physics and Astronomy). 1979. Contract AS05-79ER10459. 6p. Dep. NTIS, PC A02/MF A01.

In a magnetic field tilted with respect to the surface of Si, Beinvogl and Koch observed combined resonance transitions, resulting from a coupling of Landau levels and subband states. Because of some unexplained features in the observations, theoretical expectations are analyzed. It is concluded that unexplained discrepancies between theory and experiment still exist.

21452 (DOE/ER/10461—1) **Far infrared and thermal studies on low temperature materials. Progress report, July 1, 1979-March 15, 1980.** Huang, C. (Minnesota Univ., Minneapolis (USA). School of Physics and Astronomy). 15 Mar 1980. Contract AC02-79ER10461. 3p. Dep. NTIS, PC A02/MF A01.

Major progress in setting up the facility for the modulation far infrared spectroscopy as well as experimental results in thermal studies of V_3Si crystalline samples are described.

21453 Analysis of error in eigenvalues and eigenvectors determined from EPR data. Fouse, G.W.; Bernhard, W.A. (Univ. of Rochester, NY). *J. Magn. Resonance;* **32**: 191-198(1978).

An approximation method for estimating variance and covariance of EPR-determined eigenvalues and eigenvectors is described using the hyperfine coupling tensor A as an example. The method is tested by comparison with simulation methods. Finally, the error distribution in the eigenvalues and eigenvectors of A are calcuated for an example set of EPR single-crystal data.

SUPERCONDUCTIVITY

21454 Inhomogeneous superconductors-1979. Gubser, D.U.; Francavilla, T.L.; Wolf, S.A.; Leibowitz, J.R. (eds.). New York, NY; American Institute of Physics (1980). 349p. (CONF-791151—).

From Inhomogeneous superconductors conference; Berkeley Springs, WV, USA (1 Nov 1979).

Individual papers were abstracted separately for the data base.

THEORETICAL PHYSICS

CLASSICAL AND QUANTUM MECHANICS

21455 Effect of the choice of wave functions on theoretical predictions for symmetry breaking processes: A view from the DKP formalism. Nieto, M.M. (Los Alamos Scientific Lab., NM (USA). Theoretical Div.). pp 324-333 of Group theoretical methods in physics. Beiglboeck, W.; Boehm, A.; Takasugi, E. (eds.). Berlin, Germany, F.R.; Springer (1979).

From Colloquium on group theoretical methods in physics; Austin, TX, USA (11 Sep 1978).

When considering an elementary particle matrix element, of necessity one must make an assumption, which often goes unnoticed, as to what formalism should be used for the wave functions. A current or interaction Lagrangian-density matrix-element is of the form V = anti PSIsub(out)GAMMA PSIsub(in), where PSIsub(in) and anti PSIsub(out) represent the physical ingoing and outgoing particles, and GAMMA represents the vertex function. A current must have the dimensions of $(\text{length})^{-3} = (\text{mass})^3$ in units of $h/2\pi = c = 1$. PSIsub(in) and anti PSIsub(out) must be described in terms of the physical on-shell masses or else one has no phase space. It is only the vertex function which can be symmetric in the internal symmetry under consideration. The decision as to how much of the matrix element will be taken to be symmetric and how much of the matrix element will be taken to be associated with on-mass-shell wave functions is a fundamental assumption. Depending on how the assumption is made, different results will be predicted. Normally first-order Dirac wave functions, with dimensions (length)sup(-3/2) and second-order Klein-Gorddon wave functions with dimensions $(\text{length})^{-1}$ are considered for spin-1/2 fermions and spin-O bosons, respectively. We will discuss the types of new results which are obtained if, on the contrary, one chooses to consider bosons in the first-order Duffin-Kemmer-Petiau formalism. We will argue that the DKP formalism represents a complementary viewpoint to the spectrum generating approach. Both challenge the standard phenomenology: DKP by changing the wave function, spectrum generating by changing the vertex function.

21456 EPR paradox revisited. Cantrell, C.D.; Scully, M.O. (Univ. of Arizona, Tucson). *Phys. Rep.;* **43**: No. 13, 499-508(Jul 1978).

Einstein, Podolsky, and Rosen (EPR) argued in 1935 that quantum mechanics fails to give an adequate description of physical reality, and also cannot give a consistent wave-function description of certain phenomena. It is shown that a calculation based upon the reduced density matrix removes the formal inconsistency pointed out by EPR. The spirit of the present paper is that of a pedagogical review.

STATISTICAL PHYSICS AND THERMODYNAMICS

21457 (CONF-790477—2) **Theoretical method for determining the three-particle distribution function of classical systems.** Johnson, E. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 7p. Dep. NTIS, PC A02/MF A01.

From Annual meeting of national organization for the professional advancement of black chemists and chemical engineers; Houston, TX, USA (18 Apr 1979).

Equilibrium statistical mechanics is considered. A method that should yield accurate three-particle distribution functions is presented. None of the current methods is successful. It appears that the new equation presented may be used with the first and second equations in the YBG hierarchy to obtain exact single-particle, pair, and triplet distribution functions. It should be easy to generalize the results to the n-particle distribution function.

21458 (CONF-790682—7) **Minimum entropy production rate and Ostwald ripening.** Kuczynski, G.C. (Notre Dame Univ., IN (USA). Dept. of Metallurgical Engineering and Materials Science). Mar 1979. Contract EG-77-S-02-4385. 16p. Dep. NTIS, PC A02/MF A01.

From 5. international conference on sintering and related phenomena; Notre Dame, IN, USA (18 Jun 1979).

A system of N/sub v/ spherical particles per unit volume, where N/sub v/ is a large number, is described by some distribution function f(r,t) of particle radius and time. If the rates of increase of entropies from various sources of the system could be expressed by an integral, the problem of finding function f which would satisfy the minimum entropy production rate would be reduced to a variational problem. A new variational analysis of this problem is presented. (GHT)

MATHEMATICAL PHYSICS

21459 (SAND—80-8627) **Error estimates for piecewise perturbation series solutions of parabolic and hyperbolic equations.** Smooke, M.D. (Sandia Labs., Livermore, CA (USA)). Mar 1980. Contract EY-76-C-04-0789. 44p. Dep. NTIS, PC A03/MF A01.

By approximating the time derivative operators of a set of one-dimensional, linear, parabolic, and hyperbolic mixed initial-boundary-value problems by appropriate difference expressions, the problems can be reduced to two-point boundary-value problems at chosen time levels. The piecewise perturbation series error analysis techniques developed in an earlier paper can then be applied. The aim of this analysis is to obtain high-order approximations with respect to the space discretization by use of a given time discretization.

FUSION ENERGY

PLASMA RESEARCH

PLASMA CONFINEMENT AND HEATING

REFER ALSO TO CITATION(S) 21495

21460 (CONF-791228—, pp 59-74) **Characteristics of hot electrons in a simple magnetic mirror field.** Hosokawa, M.; Ikegami, H. (Nagoya Univ., Japan). Apr 1980.

From EBT ring physics workshop; Oak Ridge, TN, USA (3 Dec 1979).

General description is given to microwave generated plasmas in a simple magnetic mirror machine, TPM, at the Institute of Plasma Physics, Nagoya University. Spatial structure or the density profile of the hot electron plasma is discussed. Experimental studies on the evolution of energy distribution function of the hot electrons are made. Several instabilities are investigated by triggering them artificially with their effects on the density profile and energy distribution of the hot electrons.

21461 (CONF-791228—, pp 221-231) **Model kinetic equation for electron cyclotron heating of EBT rings.** Baxter, D.C. (Science Applications, Inc., La Jolla, CA); Bernstein, I.B. Apr 1980.

From EBT ring physics workshop; Oak Ridge, TN, USA (3 Dec 1979).

Calculations of single particle orbits have produced estimates of single particle heating rates for electrons which transit a region where the microwave radiation frequency equals the local electron cyclotron frequency (e.g., 1, 2, 3). A Fokker-Plank equation is derived in order to describe the evolution of an electron distribution function which is anisotropic in velocity space. Finite element numerical techniques may be used to find steady state solutions. These solutions will yield information about steady state microwave power requirements, parallel and perpendicular pressure of the ring and its longitudinal spatial distribution. (MOW)

21462 (CONF-791228—, pp 261-287) **Microwave heating of the annulus in EBT.** Batchelor, D.B. Apr 1980.

From EBT ring physics workshop; Oak Ridge, TN, USA (3 Dec 1979).

Current understanding of electron cyclotron heating in the ELMO Bumpy Torus (EBT) is reviewed and the propagation characteristics of the different modes are described for EBT geometry. Wave absorption processes near the second harmonic resonance (where the annulus is observed to form in EBT) are discussed. Calculations of single particle energy gain are presented for finite wavelength waves propagating in a magnetic mirror geometry. It is shown that the heating is highly pitch angle-dependent and the relativistic effects are quite important even at moderate energies. Calculations are presented which suggest that coherent, wave-particle interactions may be important in producing the annulus from a population of particles having small initial perpendicular energies.

21463 (CONF-791228—, pp 289-304) **Microwave interaction with hot electron plasmas.** Tanaka, M.; Fujiwara, M.; Ikegami, H. (Nagoya Univ., Japan). Apr 1980.

From EBT ring physics workshop; Oak Ridge, TN, USA (3 Dec 1979).

A numerical calculation is presented of ray trajectories and cyclotron damping for toroidal plasmas using geometrical optics. In the absorption region, group velocity does not always coincide with the velocity of energy flow, therefore it should be careful to apply the geometrical optics to finite temperature plasmas. In these calculations, attention is paid mainly to the finite temperature effect on ray tracing. Some numerical results for ordinary waves are presented. Second, new cutoff and resonance appear in the plasmas with anisotropic electron temperature. This resonance frequency is shifted from the usual cyclotron resonance by an amount proportional to T_{11}/mc^2, so that one can determine T_{11} when this resonance frequency is measured. A simple discussion is given. The results are presented of recent density measurement on Nagoya Bumpy Torus obtained by interferometer system with different frequencies, 35 GHz and 55 GHz. The results are different than each other in T-mode. The possible reasons for these differences are enumerated in this section.

21464 (CONF-791228—, pp 333-348) **Annulus power losses in EBT.** Kashuba, R.J.; Ard, W.B. (McDonnell Douglas Research Labs., St. Louis, MO). Apr 1980.

From EBT ring physics workshop; Oak Ridge, TN, USA (3 Dec 1979).

The power input required to sustain the hot electron annulus can be very important in the EBT-P device and in scaling EBT to a reactor. In order to estimate the annulus power requirements, the energy losses are calculated by classical processes in the annulus. If the annulus can be stabilized against drift instabilities, as is the case in the simple mirrors and EBT-I, the classical losses should dominate the power requirements. The classical loss processes are averaged over a two-dimensional relativistic distribution with temperatures characteristic of x-ray bremsstrahlung measurements. The loss rate is found to have a minimum as a function of annulus temperature and density. In addition the power balance of an ion annulus for EBT is examined. The power balance is shown to be favorable for a reactor and a meaningful experiment will be considered for EBT-P.

21465 (CONF-791228—, pp 349-361) **Optimization of EBT annulus power drain with respect to core properties.** Vella, M.C. (Univ. of California, Berkeley). Apr 1980.

From EBT ring physics workshop; Oak Ridge, TN, USA (3 Dec 1979).

The possibility of reducing the importance of EBT annulus power drain in the reactor regime has been explored by scaling in ω/ sub pe//Ω/sub ce/, or, equivalently, in d = n/sub cr//n/sub c/. A natural scaling advantage at high d is pointed out by comparing the annulus power drain to the core power and energy transport per unit volume, P/sub a//P/sub cr/. The results indicate that, even with microwaves, a significant improvement over present operation, d = 0.5, may be possible.

21466 (CONF-791228—, pp 363-379) **Steady-state microwave power requirements for EBTR electron rings.** Andrade, A.; Krakowski, R.A.; Bathke, C.G. (Los Alamos Scientific Lab., NM). Apr 1980.

From EBT ring physics workshop; Oak Ridge, TN, USA (3 Dec 1979).

The non-relativistic slowing-down equations were used in order to obtain analytic expressions of electron-ring losses in a reactor-grade plasma. The formalism used to estimate collisional drag losses is developed. This formalism is then applied to a range of assumed electron ring energy distributions. A parametric analysis of the effects of the parameters β/sub R/, F/sub R/, and ϵ/sub R/ on reactor performance is given. It is emphasized that this analysis is highly approximate, but the results indicate strongly the need for a more careful resolution of this problem for the EBT reactor embodiment.

21467 (COO—2218-151) **Heating by collisional slowing of fast ions in non-circular tokamaks.** Hively, L.M.; Rome, J.; Miley, G.H. (Illinois Univ., Urbana (USA). Fusion Studies Lab.). 1980. Contract EY-76-S-02-2218. 3p. (CONF-800607—1). Dep. NTIS, PC A02/MF A01.

From American Nuclear Society annual meeting; Las Vegas, NV, USA (8 Jun 1980).

Plasma heating by energetic, charged fusion-products is a crucial issue for obtaining fusion reactors conditions. The evolution of alpha particle density, momentum, kinetic energy and heat flux is important in the study of start-up and ignition scenarios as well as in steady-state operation. Since fast ions have large banana-width guiding-center orbits in tokamaks, the usual locally-defined particle distribution function loses its usefulness. Accordingly, the fast ion collisional slowing-down problem has been formulated to describe these orbits in an axisymmetric, non-circular tokamak.

21468 (LAPS—55) **Possibility of achieving ignition in a high field ohmically heated tokamak.** Wagner, C.E. (Science Applications, Inc., La Jolla, CA (USA). Lab. for Applied Plasma Studies). Apr 1980. Contract EY-76-C-03-1018. 21p. (SAI—023-80-309LJ). Dep. NTIS, PC A02/MF A01.

There exists a regime in parameter space where a small high-field ohmically-heated tokamak may be capable of reaching thermonuclear ignition. Results of numerical simulations of the minimum ignition conditions are presented which include empirical, sawtooth, and magnetic field ripple diffusion and the effects of impurities. An ignition condition is derived and compared with the results of the numerical simulations.

21469 (UCRL-Trans—11527) **Transverse confinement of high-pressure plasma in a corrugated magnetic field.** Musher, S.L.; Spektor, M.D. (AN SSSR, Novosibirsk. Inst. Avtomatiki i Ehlektrometrii). Nov 1979. Translation of Preprint No. 94. 26p. Dep. NTIS, PC A03/MF A01.

The confinement of a high-pressure plasma in a multi-mirror magnetic configuration with a corrugated metallic shell is studied analytically and numerically. Equations that describe the dynamics of a dense plasma in a corrugated magnetic field are derived in the paper, and it is shown that the structure of the magnetic field lines is preserved when the hot plasma expands transversely, and that the energy lifetime tau/sub perpendicular/ is of order R^2/chi (where chi is Bohm's thermal diffusivity).

PLASMA DIAGNOSTICS

21470 (CONF-791228—, pp 305-316) **Synchrotron radiation from the ring and nonlinear effects in microwave heating of EBT.** Tripathi, V.K.; Ott, E.; Liu, C.S. (Univ. of Maryland, College Park). Apr 1980.

From EBT ring physics workshop; Oak Ridge, TN, USA (3 Dec 1979).

A computer program is being developed for the spectral distribution of synchrotron radiation, especially at higher harmonics, from the ring. Using the single particle emission coefficients as given by Bekefi, the expressions were obtained for the intensity of radiation in the ordinary and extraordinary modes. The radiation is primarily coming from the hot electron ring with parameters: n/sub h/ $\sim 10^{11}$ cm^{-3}, T/sub h/ $\sim$ 0.2 to 2 MEV, radius $\sim$ 12 to 15 cm, width $\sim$ 5 to 7 cm, thickness $\sim$ 3 to 4 cm. We have assumed a Gaussian profile for electron density and a consistent profile for magnetic field is deduced, using the pressure balance. The electron distribution function is taken to lie in the narrow pitch angle cone. The interest is restricted to perpendicular radiation, where relativistic effects are pronounced.

21471 (CONF-791228—, pp 527-532) **Diagnostics: summary of the open session.** Haste, G.R. Apr 1980.

From EBT ring physics workshop; Oak Ridge, TN, USA (3 Dec 1979).

In the EBT area, a list was presented of the present diagnostics which are applicable to the ring measurements. Also presented was a list of possible future diagnostics which will give some information on the ring. These lists are summarized.

PLASMA KINETICS - GENERAL

21472 (CONF-791228—, pp 143-161) **Diamagnetic measurements for experimental determination of EBT ring parameters.** Carpenter, K.H. (Univ. of Missouri, Rolla). Apr 1980.

From EBT ring physics workshop; Oak Ridge, TN, USA (3 Dec 1979).

A mathematical model is described for the annulus of a typical EBT plasma. The use of the model for energy and length observations is described. (MOW)

PLASMA KINETICS - EXPERIMENTAL

21473 (CONF-791103—102) **ISX-B impurity study program.** Langley, R.A. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 8p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

A review of some of the problems associated with tokamak impurities is given. The ISX research program is described. (MOW)

21474 (GA-A—15801) **Preliminary results of noncircular plasma experiments in Doublet III.** Ohkawa, T. (General Atomic Co., San Diego, CA (USA)). Feb 1980. Contract AT03-76ET51011. 17p. Dep. NTIS, PC A02/MF A01.

Preliminary results of noncircular plasma experiments in Doublet III are reported. Shaping and discharge characteristics in doublet plasmas with high-Z limiters are described. Electron energy confinement and maximum plasma density are in agreement with standard circular tokamak empirical scaling laws. Chromium and molybdenum appear to be the dominant high-Z contaminants while carbon appears to dominate low-Z contaminants. High-Z impurity radiation does not appear to dominate the central power balance.

21475 (LA—7684-MS) **Opacity test using a neon-seeded theta pinch.** Thomson, D.B. (Los Alamos Scientific Lab., NM (USA)). Feb 1980. Contract W-7405-ENG-36. 30p. Dep. NTIS, PC A03/MF A01.

Vacuum ultraviolet (VUV) emission from a neon-seeded high-density theta-pinch has been observed for comparison with theoretical radiation emission calculations. The plasma was created in a 25-cm-long theta-coil with 90-kG field having a 3.0-μs quarter period. A gas fill of 1 torr of helium + 2% neon was used. Observation of the HeII 4686 line/continuum ratio gave an electron temperature of 25 +- 4 eV. Shadowgraphs of the plasma radius, taken with a ruby laser, gave an electron density of 0.9 +- 0.09 x 10^{16} cm^{-3}. The VUV emission was observed in radial view and with time resolution with a 2.2-m grazing-incidence monochromator equipped with a photomultiplier and p-terphenyl scintillator. Thin foils of carbon and aluminum were used as filters to absorb stray light and pass emission in the 44- to 100-A region.

21476 (PPPL—1520) **QED-1 device and measurements of gettering efficiency for a simulated divertor plasma.** Owens, D.K.; Yamada, M. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Mar 1980. Contract EY-76-C-02-3073. 44p. Dep. NTIS, PC A03/MF A01.

The QED-1 device at PPL has provided gettering efficiency data for neutralized hydrogen plasma on titanium. The hollow-anode arcjet produces a plasma column 1 cm in diameter with $10^{12} <$ n/sub e/ $< 10^{15}$ cm^{-3} and T/sub i/ $<$ T/sub e/ = 3-10 eV, confined by an axial magnetic field of 1-6 kG. The gettering measurements are based on monitoring neutral gas density with respect to time in the divertor simulation chamber of QED-1. The present results indicate that the plasma particles lose their charge and most of their energy when they strike the neutralizer plate.

21477 (PPPL—1644) **Observations of giant recombination edges on PLT tokamak induced by particle transport.** Brau, K.; von Goeler, S.; Bitter, M.; Cowan, R.D.; Eames, D.; Hill, K.; Sauthoff, N.; Silver, E.; Stodiek, W. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Mar 1980. Contract EY-76-C-02-3073. 30p. Dep. NTIS, PC A03/MF A01.

Characteristic steps in the continum spectrum of high temperature tokamak plasmas associated with recombination radiation from impurity ions were observed. During special argon-seeded discharges on the Princeton Large Torus (PLT) tokamak the x-ray spectrum exhibited large enhancements over the bremsstrahlung continuum beginning with energies of 4.1 keV. This corresponds to the radiative capture of free electrons by hydrogen-like argon into the ground state of helium-like argon. A simple particle diffusion model is proposed, with the Ar XVIII radial profiles evaluated from the size of the recombination edges. For the case of moderate density ($<$ n/sub e/ $>$ $\sim$ 3 x 10^{13} cm^{-3}) and temperature [T/sub e/ (0) $\sim$ 1.5 keV] discharges the outward radial transport velocity is found to be approximately 10 m/sec.

21478 (UCRL—84284) **Plasma focus experiments with DT-filled microballoons.** Sahlin, H.L.; Hasegawa, T.H.; Pickles, W.L.; Price, D.F.; Wainwright, T.E.; McClure, J.W.; Gullickson, R.L.; Luce, J.S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1978. Contract W-7405-ENG-48. 4p. (CONF-781247—7). Dep. NTIS, PC A02/MF A01.

From 2. international conference on energy storage, compression and switching; Venice, Italy (5 Dec 1978).

Experiments with DT-filled glass microballoons positioned near the pinch region of a plasma focus have resulted in the production of neutrons which do not appear to be due to D-T reactions.

PLASMA KINETICS - THEORETICAL

REFER ALSO TO CITATION(S) 21504

21479 (CONF-791228—, pp 193-219) **Numerical calculation of the electron distribution function for EBT electron annuli.** Tolliver, J.S.; Jaeger, E.F.; Hedrick, C.L. Apr 1980.

From EBT ring physics workshop; Oak Ridge, TN, USA (3 Dec 1979).

In the ELMO Bumpy Torus (EBT), high beta relativistic electron annuli in each mirror sector provide the average minimum-B configuration necessary for stability of the toroidal plasma. A nonrelativistic bounce-averaged kinetic equation is solved for the electron distribution function, which is assumed to be isotropic in velocity space. The equation is solved in time and two dimensions and includes both velocity and radial derivatives. The Fokker-Planck collision operator includes Coulomb collisions and first- and second-harmonic microwave heating terms. Ionization of cold neutrals (assuming a cylindrical neutral transport model) provides a source of cold electrons.

21480 (COO—2218-156) **Fusion-product transport in axisymmetric tokamaks: losses and thermalization.** Hively, L.M. (Illinois Univ., Urbana (USA). Fusion Studies Lab.). 1980. Contract AC02-76ET52040. 210p. Dep. NTIS, PC A10/MF A01.

Thesis.

High-energy fusion-product losses from an axisymmetric tokamak plasma are studied. Prompt-escape loss fluxes (i.e. prior to slowing down) are calculated including the non-separable dependence of flux as a function of poloidal angle and local angle-of-incidence at the first wall. Fusion-product (fp) thermalization and heating are calculated assuming classical slowing down. The present analytical model describes fast ion orbits and their distribution

function in realistic, high-β, non-circular tokamak equilibria. First-orbit losses, trapping effects, and slowing-down drifts are also treated.

21481 (GA-A—15327) **ZEROD: a zero dimensional, time dependent tokamak plasma simulation code for reactor scoping studies.** Hacker, M.P. (General Atomic Co., San Diego, CA (USA)). Feb 1980. Contract AT03-76ET51011. 85p. Dep. NTIS, PC A05/MF A01.

ZEROD integrates in time the volume-averaged electron and ion energy balance equations, as well as particle balance equations for the various ion species. The ion species included are deuterium, tritium, thermal alpha particles, and one impurity species. The code incorporates models for plasma heating via neutral deuterium beam injection, rf heating by waves in the lower-hybrid frequency regime, control of the burn thermal equilibrium, and fueling. Geometric quantities such as the plasma volume, surface area, profile averaging factors, etc., are calculated on the basis of realistic models for the plasma cross-sectional shape, including circles, ellipses, dees, and doublets.

21482 (LA—8261-MS) **Zero dimensional plasma model and the study of the initial performance of the ZT-40 experiment.** Ortolani, S. (Los Alamos Scientific Lab., NM (USA)). Feb 1980. Contract W-7405-ENG-36. 46p. Dep. NTIS, PC A03/MF A01.

A plasma zero-dimensional model is described and some results obtained to study the initial performance of the ZT-40 experiment are discussed.

21483 (PPPL—1633) **Charge exchange as a recombination mechanism in high-temperature plasmas.** Hulse, R.A.; Post, D.E.; Mikkelsen, D.R. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Mar 1980. Contract EY-76-C-02-3073. 38p. Dep. NTIS, PC A03/MF A01.

Charge exchange with neutral hydrogen is examined as a recombination mechanism for multi-charged impurity ions present in high-temperature fusion plasmas. At sufficiently low electron densities, fluxes of atomic hydrogen produced by either the injection of neutral heating beams or the background of thermal neutrals can yield an important or even dominant recombination process for such ions. Equilibrium results are given for selected impurity elements showing the altered ionization balance and radiative cooling rate produced by the presence of various neutral populations. A notable result is that the stripping of impurities to relatively non-radiative ionization states with increasing electron temperature can be postponed or entirely prevented by the application of intense neutral beam heating power. A time dependent calculation modelling the behavior of iron in recent PLT tokamak high power neutral beam heating experiments is also presented.

21484 (PPPL—1652) **Noncanonical Hamiltonian density formulation of hydrodynamics and ideal MHD.** Morrison, P.J.; Greene, J.M. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Apr 1980. Contract EY-76-C-02-3073. 15p. Dep. NTIS, PC A02/MF A01.

A new Hamiltonian density formulation of a perfect fluid with or without a magnetic field is presented. Contrary to previous work the dynamical variables are the physical variables, rho, v, B, and s, which form a noncanonical set. A Poisson bracket which satisfies the Jacobi identity is defined. This formulation is transformed to a Hamiltonian system where the dynamical variables are the spatial Fourier coefficients of the fluid variables.

21485 (LA-tr—80-3) **Numerical modelling of the compression of a toroidal plasma by a quasispherical liner.** Gasilov, V.A.; Goloviznin, V.M.; Kurtmullaev, R.Kh.; Semonov, V.N.; Sosnin, N.V.; Tishkin, V.F.; Favorskii, A.P.; Shashkov, M.Yu. (AN SSSR, Moscow. Inst. Prikladnoj Matematiki). 1980. Translation of IPM Preprint, 1979. 37p. Dep. NTIS, PC A03/MF A01.

The problem of the dynamics of a heavy profiled envelope, compressing a compact plasma toroid with a frozen-in magnetic field, is resolved numerically. It is shown that, by the successful profiling of velocity at the initial moment, such a mode of compression of the plasma may be achieved, that, starting from some time, the form of the cavity under the liner is close to quasispherical. In this mode, the compression coefficient may reach 10^3.

PLASMA INSTABILITIES

21486 (CONF-791228—, pp 75-96) **Review of EBT electron ring stability.** Spong, D.A. Apr 1980.

From EBT ring physics workshop; Oak Ridge, TN, USA (3 Dec 1979).

High beta electron rings are an essential ingredient in maintaining the stability of the EBT toroidal core plasma. By forming a magnetic well of sufficient depth at the plasma edge, the rings provide stabilization against flute and interchange, and at higher toroidal core betas they enhance stability against ballooning modes. In defining stable operating regimes for the toroidal plasma, it is therefore necessary to understand the ring stability boundaries. Due to the simultaneous importance of kinetic, finite geometry, and profile effects, the general problem of ring stability is complex and has been examined in the past only with certain simplified models. In this paper, previous work in this area will be reviewed.

21487 (CONF-791228—, pp 97-120) **Brief review of ELMO ring stability theory.** Guest, G.E. (General Atomic Co., San Diego, CA). Apr 1980.

From EBT ring physics workshop; Oak Ridge, TN, USA (3 Dec 1979).

The following topics are discussed: (1) stability of the ELMO rings in the anisotropic guiding-center model, (2) stability in the kinetic theory model, (3) control of the cold-plasma concentration, and (4) limits on bumpy torus stabilization by ELMO rings. (MOW)

21488 (CONF-791228—, pp 409-436) **Macroscopic stability of the hot electron annulus in EBT.** Miller, R.L.; Dominguez, R.R.; Guest, G.E.; Ohkawa, T. (General Atomic Co., San Diego, CA). Apr 1980.

From EBT ring physics workshop; Oak Ridge, TN, USA (3 Dec 1979).

One stability question concerning the ELMO Bumpy Torus (EBT) which has received little attention is the macroscopic stability of the hot electron annulus. Previous macroscopic stability studies have concentrated on localized modes. Kinetic theory may be used to determine how hard (rigid) or soft (perturbable) the rings are for idealized perturbations in a slab geometry. However in this macroscopic analysis, a realistic geometry and a bumpy cylinder with a 2:1 magnetic mirror ratio are used. The pessimistic assumption is made that the rings are soft. Guiding center theory (with p/sub perpendicular to/ >> p/sub parallel/) is used to study the second variation in the plasma energy (δ W) using a finite element representation to identify the least stable mode for the hot electron ring. Stability boundaries will be established by considering a wide range of anisotropic high-β equilibrium models of the ELMO rings.

21489 (CONF-791228—, pp 453-470) **Stability of a toroidal plasma by hot electron annulus in a bumpy torus.** Sanuki, H.; Fujiwara, M. (Nagoya Univ., Japan). Apr 1980.

From EBT ring physics workshop; Oak Ridge, TN, USA (3 Dec 1979).

An analytical study of the ballooning instability is presented in a bumpy configuration using a relatively simple fluid model of an inhomogeneous slab plasma with gravitational field simulating the bad curvature effect and the grad-B effect due to hot electron annulus. Mathieu type equation is derived to investigate a linear analysis. Stability boundary giving the maximum stable β/sub p/ (beta value of bulk plasma) as a function of β/sub h/ and the threshold for β/sub h/ (beta value of hot electron annulus) are studied for Nagoya Bumpy Torus (NBT) parameters. The relevance of the theoretical analysis is discussed in a comparison with the previous results.

21490 (CONF-791228—, pp 471-489) **Stability analysis of a hot electron EBT plasma.** Van Dam, J.W.; Lee, Y.C. (Inst. for Advanced Study, Princeton, NJ). Apr 1980.

From EBT ring physics workshop; Oak Ridge, TN, USA (3 Dec 1979).

Previous theoretical studies have predicted that an EBT-confined plasma will have a stable equilibrium for beta values of the toroidal core plasma comparable to the beta value for the hot electron annulus. It is shown that, when the ring is allowed to be perturbed, there is a new physical effect, enhanced compression of the core plasma; that in the limit of negligible β/sub core/, the interchange mode is stable for β/sub ring/ greater than about 20%, as was found before; but that when the core pressure is increased, the plasma goes unstable again at values of β/sub core/ significantly smaller than the value for β/sub ring/.

21491 (CONF-791228—, pp 495-498) **Instabilities in hot electron plasmas: summary of the open session.** Vella, M.C. (Univ. of California, Berkeley). Apr 1980.

From EBT ring physics workshop; Oak Ridge, TN, USA (3 Dec 1979).

Twenty years of experimental and theoretical investigation of instabilities in hot electron plasmas were surveyed. Attention focused on phenomena occurring in simple mirror experiments and their possible relevance to the T-M transition presently observed in EBT and NBT.

21492 (CONF-791228—, pp 499-502) **Instabilities in mirror confined hot electron plasmas.** Ard, W.B. (McDonnell Douglas Corp., St. Louis, MO). Apr 1980.

From EBT ring physics workshop; Oak Ridge, TN, USA (3 Dec 1979).

Early experiments on ECRH plasmas in simple mirrors showed that under some operating conditions rapid losses of a considerable fraction of the plasma energy could occur. Further observations allowed the identification of two distinct modes of

instability. These experiments were carried out in the PTF device at ORNL about 1965 to 1966. The PTF device was a simple mirror machine heated with up to 4 kW of ECRH power at a frequency of 10.6 GHz. The plasma radius in the midplane was about 10 cm.

21493 (LA-UR—80-738) **Resistive G-modes and ballooning.** Dagazian, R.Y.; Mondt, J.P.; Paris, R.B. (Los Alamos Scientific Lab., NM (USA); Association Euratom, Fontenay-aux-Roses (France)). 1980. Contract W-7405-ENG-36. 12p. (CONF-800435—1). Dep. NTIS, PC A02/MF A01.

From Workshop on optimization of toroidal confinement; Hiroshima, Japan (14 Apr 1980).

A unified theory of the linear stability of the Roberts and Taylor type of resistive interchange and ballooning is presented. The effects of both parallel and perpendicular viscosity as well as of finite shear and finite β are included in a MHD treatment of the problem. Kinetic effects are also studied. The hybrid kinetic model with Vlasov ions and guiding center electrons has been appropriately generalized to allow for electron-ion collisions. The geometry is that of a plane slab with magnetic shear.

21494 (PPPL—1643) **Ballooning mode theory of drift-waves and trapped-electron modes in tokamaks.** Cheng, C.Z.; Chen, L.; Chance, M.S. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Mar 1980. Contract EY-76-C-02-3073. 8p. (CONF-800409—4). Dep. NTIS, PC A02/MF A01.

From International conference on plasma physics; Nagoya, Japan (7 Apr 1980).

Employing the ballooning mode formalism, the two-dimensional eigenmode equation for drift-waves and trapped-electron modes is reduced to a one-dimensional integro-differential equation along the magnetic field lines with the radial structure determined by a WKB procedure. Two types of eigenmodes are identified. One is the slab-like, which corresponds to an unbounded eigenmode, which experiences enhanced shear damping and always remains stable. The second is the toroidicity-induced branch, which corresponds to an eigenstate quasibounded by local potential wells and which can become absolutely unstable.

PLASMA WAVE PHENOMENA

21495 (DOE/ER/53093—1) **Alfven wave.** Hasegawa, A.; Uberoi, C. (Bell Labs., Murray Hill, NJ (USA); Columbia Univ., New York (USA); Indian Inst. of Science, Bangalore. Dept. of Applied Mathematics). Nov 1978. Contract ACO2-80ER53093. 254p. Dep. NTIS, PC A12/MF A01.

Seven chapters are included. Chapters 1 and 2 introduce the Alfven wave and describe its linear properties in a homogeneous medium. Chapters 3 and 4 cover the effects of inhomogeneities on these linear properties. Particular emphasis is placed on the appearance of a continuum spectrum and the associated absorption of the Alfven wave which arise due to the inhomogeneity. The explanation of the physical origin of absorption is given using kinetic theory. Chapter 5 is devoted to the associated plasma instabilities. Nonlinear effects discussed in Chapter 6 include quasilinear diffusion, decay, a solitary wave, and a modulational instability. The principles of Alfven wave heating, a design example and present-day experimental results are described in Chapter 7.

FUSION POWER PLANT TECHNOLOGY

21496 (CONF-791228—) **EBT ring physics.** Uckan, N.A. (ed.). (Oak Ridge National Lab., TN (USA)). Apr 1980. Contract W-7405-ENG-26. 548p. Dep. NTIS, PC A23/MF A01.

From EBT ring physics workshop; Oak Ridge, TN, USA (3 Dec 1979).

This workshop attempted to evaluate the status of the current experimental and theoretical understanding of hot electron ring properties. The dominant physical processes that influence ring formation, scaling, and their optimal behavior are also studied. Separate abstracts were prepared for each of the 27 included papers. (MOW)

21497 (CONF-791228—, pp 505-506) **Power balance implications for a reactor: summary of the open session.** Ard, W.B. (McDonnell Douglas Corp., St. Louis, MO). Apr 1980.

From EBT ring physics workshop; Oak Ridge, TN, USA (3 Dec 1979).

The consensus from the open session discussions on ring power balance was that the identified energy loss processes (drag, scattering, and synchrotron radiation) and the estimates of energy loss as a function of hot electron temperature, magnetic field, and plasma parameters are probably correct. The microwave power required to sustain the rings in EBT-I, NBT, and recently in EBT-S is modest and reasonably well estimated by the theoretical models. There was, however, a considerable amount of discussion about how the total power to sustain the rings would scale to a reactor.

21498 (CONF-791228—, pp 507-523) **Ring power balance implications for a reactor.** Uckan, N.A. Apr 1980.

From EBT ring physics workshop; Oak Ridge, TN, USA (3 Dec 1979).

Self-consistent treatment of the problem requires consideration of the following: (1) particle orbits, (2) heating and formation, (3) equilibrium and stability requirements, (4) ring-core interaction, (5) scaling, and (6) power balance. Each of the more than two dozen papers (experimental and theoretical presented at this workshop covered one or more of these areas and treated them in different ways by emphasizing their relative importance. Some conclusions from the meeting are summarized. (MOW)

21499 (DOE/TIC—11186) **Recent experimental results from ISX-B.** Murakami, M. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 60p. Dep. NTIS, PC A04/MF A01.

The ORNL tokamak program is reviewed. Specifications for the ISX tokamak are given along with graphs showing the most significant experimental achievements. (MOW)

BLANKET ENGINEERING

REFER ALSO TO CITATION(S) 20887

21500 (WFPS-TME—79-021) **Blanket design study for a Commercial Tokamak Hybrid Reactor (CTHR).** Chapin, D.L.; Green, L.; Lee, A.Y.; Culbert, M.E.; Kelly, J.L. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Fusion Power Systems Dept.). Sep 1979. Contract EG-77-C-02-4544. 129p. Dep. NTIS, PC A07/MF A01.

The results are presented of a study on two blanket design concepts for application in a Commercial Tokamak Hybrid Reactor (CTHR). Both blankets operate on the U-Pu cycle and are designed to achieve tritium self-sufficiency while maximizing the fissile fuel production within thermal and mechanical design constraints. The two blanket concepts that were evaluated were: (1) a UC fueled, stainless steel clad and structure, helium cooled blanket; and (2) a UO_2 fueled, zircaloy clad, stainless steel structure, boiling water cooled blanket. Two different tritium breeding media, Li_2O and LiH, were evaluated for use in both blanket concepts. The use of lead as a neutron multiplier or reflector and graphite as a reflector was also considered for both blankets.

MAGNET COILS AND FIELDS

21501 (CONF-791228—, pp 31-57) **Review of ring experiments.** Dandl, R.A. (TRW, Redondo Beach, CA). Apr 1980.

From EBT ring physics workshop; Oak Ridge, TN, USA (3 Dec 1979).

This review covers early and late experimental manifestations of hot electron ring plasmas in PTF in the late 1960s and in EBT in 1973, followed by more detailed ring data from the ELMO experiments in the late 1960s. These data include ring temperature density and stored energy measurements as a function of combinations of heating frequencies (i.e., upper and lower off-resonance heating as well as varied resonant frequencies), unfolded high beta equilibria, some instability signatures and parameter variations with heating power frequency and pressure. Finally, some ring profile information from the EBT experiment, including skimmer profile measurements and pressure-ring parameter measurements is presented. (MOW)

21502 (CONF-791228—, pp 123-141) **Ring formation in Nagoya Bumpy Torus.** Fujiwara, M.; Hosokawa, M.; Iguchi, H.; Shoji, T.; Tanaka, M.; Sanuki, H.; Ikegami, H. (Nagoya Univ., Japan). Apr 1980.

From EBT ring physics workshop; Oak Ridge, TN, USA (3 Dec 1979).

Nagoya Bumpy Torus (NBT) is the toroidal confinement device in which the plasma is produced, heated and stabilized by the electron cyclotron heating at four microwave frequencies of 18 GHz, 10.5 GHz, 8.5 GHz (main microwave power source), and 6.4 GHz. The size is very similar to EBT-1 device and the magnetic field strength is 1/2 of EBT-1 but it is possible to feed the maximum input power level up to 155 kW. One of the main objects of NBT is to study and obtain the scaling law of the plasma confinement by comparing the NBT (8.5 GHz, 3 kG) data with the result of EBT-1 (18 GHz, 6 kG) and EBT-s (28 GHz, 10 kG). The other purpose is to study the basic physics of bumpy torus plasma, that is to say, the mechanism of ring formation, the build up of plasma potential well and the physical process of the steady toroidal current generation. In this paper the global behavior of the plasma is described briefly and the experimental results are reported about the details of obtaining hot electrons. The numerical results for drift surfaces are presented.

21503 (CONF-791228—, pp 163-172) **Comparison of energetic electron formation in EBT and in minimum-B configurations.** Haste, G.R. Apr 1980.

From EBT ring physics workshop; Oak Ridge, TN, USA (3 Dec 1979).

The energetic electrons in EBT are observed to form an annulus at the position where the applied microwave frequency is twice the local (cold) electron cyclotron frequency. The axial extent of these rings is not accurately known, but there are indications that they lengthen as the stored energy increases. By contrast, in an open-ended minimum-B geometry the energetic electrons were observed to form in a region in which there was no possibility of second harmonic resonance. The axial extent of the energetic electron population was observed to decrease as the stored energy increased.

21504 (CONF-791228—, pp 175-191) **Hot electron ring equilibria and effects on EBT transport.** Owen, L.W.; Jaeger, E.F.; Hedrick, C.L. Apr 1980.

From EBT ring physics workshop; Oak Ridge, TN, USA (3 Dec 1979).

Averaging the EBT transport equations along magnetic field lines introduces geometric form factors into the 1-D equations. These form factors are modified by changes in the magnetic field produced by the hot electron rings. On the basis of a small number of numerically determined 2-D magnetic equilibria, it is tentatively concluded that overall the form factors do appear to be important in determining the core density and temperature profiles in the region occupied by the hot electron rings.

21505 (CONF-791228—, pp 233-252) **Model for electron ring formation in EBT.** Hamasaki, S.; Klein, H.H.; Krall, N.A.; McBride, J.B.; Sperling, J.L. (JAYCOR, Del Mar, CA). Apr 1980.

From EBT ring physics workshop; Oak Ridge, TN, USA (3 Dec 1979).

A model is described for electron ring formation in EBT using a relativistically correct heating rate, based on the quasilinear interaction of the electrons with the microwave electric fields. The steady state ring temperature, the radial extent of the rings, and thus the power required to sustain the rings are determined by balancing the line averaged heating rate against existing expressions for the classical energy loss processes of the ring electrons. The role of second harmonic heating in the formation of the rings and the role of relativistic effects in determining the steady state ring temperature are emphasized.

21506 (CONF-791228—, pp 253-257) **Anisotropy of the EBT ring electrons.** Boozer, A.H. (Princeton Plasma Physics Lab., NJ). Apr 1980.

From EBT ring physics workshop; Oak Ridge, TN, USA (3 Dec 1979).

It is shown that the hot electron pressure of the EBT rings tends to be close to isotropic and the hot electron density essentially constant along the field lines. In the analysis, a square well model of the magnetic field is used. The kinetic equation is solved by using a variety of forms for psi with the assumption that the cold background electrons dominate the collisional effects due to their higher density.

21507 (CONF-791228—, pp 319-332) **Ring power balance.** Borowski, S.K.; Uckan, N.A.; Jaeger, E.F.; Kammash, T. Apr 1980.

From EBT ring physics workshop; Oak Ridge, TN, USA (3 Dec 1979).

The ring power balance has provided valuable information concerning the relativistic electron rings in ELMO Bumpy Torus (EBT). Annulus microwave power scaling is reviewed and the importance of stability and ring/core coupling is discussed in connection with the proposed EBT-P device and a potential EBT fusion reactor.

21508 (COO—4182-T1) **MIT-12T-Coil Program. Quarterly progress report for period ending 30 September 1979.** (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). 1979. Contract EG-77-S-02-4182. 9p. Dep. NTIS, PC A02/MF A01.

The MIT-12T-Coil Program is one year old. A preliminary design was completed and a review of that design by Westinghouse was initiated. Superconductor development work is progressing at both Supercon, Inc. and Airco. Airco has also been commissioned to fabricate a 300 m length of copper-based conductor, which will be used for winding exercises. Experiments to evaluate the behavior of Airco and Supercon, Inc.'s Nb_3Sn materials at 12 tesla have been completed.

21509 (COO—4182-T2) **MIT-12T-Coil Program. Quarterly progress report, April 1, 1979-June 30, 1979.** (Massachusetts Inst. of Tech., Cambridge (USA). Francis Bitter National Magnet Lab.). 21 Jul 1979. Contract EG-77-S-02-4182. 8p. Dep. NTIS, PC A02/MF A01.

The objective of this program is to design, construct, and test a 1 m diameter solenoid using multifilamentary Nb_3Sn internally cooled superconductors. Brief discussions on each objective are given. (MOW)

21510 (UCRL—84228) **Field reversal produced by a plasma gun.** Hartman, C.W.; Condit, W.; Granneman, E.H.A.; Prono, D.; Smith, A.C. Jr.; Taska, J.; Turner, W.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 2 Apr 1980. Contract W-7405-ENG-48. 11p. (CONF-800441—1). Dep. NTIS, PC A02/MF A01.

From International symposium on physics and open-ended fusion systems; Tsukuba, Japan (15 Apr 1980).

Experimental results are presented of the production of Field-Reversed Plasma with a high energy coaxial plasma gun. The gun is magnetized with solenoids inside the center electrode and outside the outer electrode so that plasma emerging from the gun entrains the radial fringer field at the muzzle. The plasma flow extends field lines propagating a high electrical conductivity, the flux inside the center electrode should be preserved. However, for low flux, the trapped flux exceeds by 2 or more the initial flux, possibly because of helical deformation of the current channel extending from the center electrode.

21511 (WFPS-TME—80-003) **Determination of nonaxisymmetric equilibrium.** Elkin, D. (Columbia Univ., New York (USA). Dept. of Applied Physics and Nuclear Engineering). Jan 1980. Contract EG-77-C-02-4231. 44p. Dep. NTIS, PC A03/MF A01.

Thesis.

The Princeton Equilibrium Code is modified to determine the equilibrium surfaces for a large aspect ratio toroidal system with helical magnetic fields. The code may easily be made to include any variety of modes. Verification of the code is made by comparison with an analytic solution for $l = 3$. Previously observed shifting of the magnetic axis with increasing pressure or with a changed externally applied vertical field is obtained. The case $l = 0$, a bumpy torus, gives convergence only for the lenient convergence tolerance of $\epsilon/\text{sub } b/ = 1.0 \times 10^{-2}$.

COOLING SYSTEMS

21512 (ANL/FPP/TM—130) **Evaluation of organic moderator/coolants for fusion breeder blankets.** Romero, J.B. (Argonne National Lab., IL (USA)). Mar 1980. Contract W-31-109-ENG-38. 27p. Dep. NTIS, PC A03/MF A01.

Organic coolants have several attractive features for fusion breeder blanket design. Their apparent compatibility with lithium and their ideal physical and nuclear properties allows straightforward, high performance designs. Radiolytic damage can be reduced to about the same order as comparable fission systems by using multiplier/stripper blanket designs. Tritium recovery from the organic should be straightforward, but additional data is needed to make a better assessment of the economics of the process.

21513 (CONF-800401—6) **Mass transfer deposits in lithium-type 316 stainless steel thermal-convection loops.** Tortorelli, P.F.; DeVan, J.H. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 16p. Dep. NTIS, PC A02/MF A01.

From 2. international conference of liquid metal technology for energy systems; Richland, WA, USA (20 Apr 1980).

In spatially nonisothermal flowing liquid metal systems, selected constitutents of the containment materials characteristically dissolve into the liquid metal in the hotter zones and are deposited in the colder areas. The accumulation of deposits is often a more serious problem than dissolution because of attendant flow restrictions and, in reactor applications, the aggregation of radioactive species in the coolant circuits. Accordingly, the deposition processes in lithium-type 316 stainless steel thermal convection loops is studied. The morphology and composition of deposits varied with loop operating time. Initially, chromium-rich dendritic crystals formed in the colder region of a loop, but later the deposits changed in structure and contained significant amounts of nickel and iron. Deposition rates were also measured as a function of time and temperature and were correlated with the above observations. A plug extracted from one loop consisted of an aggregate of chromium-rich crystals.

HEATING AND FUELING SYSTEMS

REFER ALSO TO CITATION(S) 21525

21514 (ANL/FPP/TM—128) **Impact of alternate fusion fuels on fusion reactor technology: an initial assessment study.** Baker, C.C.; Bolon, A.; Clemmer, R. (Argonne National Lab., IL (USA); Illinois Univ., Urbana (USA)). Nov 1979. Contract W-31-109-ENG-38. 126p. Dep. NTIS, PC A07/MF A01.

The initial results of a study carried out to assess some of the technology implications of non-D-T fusion fuel cycles are presented. The primary emphasis in this report is on D-D, catalyzed-D and D-^{3}He fuel cycles. Tokamaks and field-reversed mirrors have been selected as sample confinement concepts. A new technique of employing neutronic computer codes to study the transport of cyclotron radiation for cases of non-uniform density and temperature profiles is described. The technology areas considered include first

wall design considerations, shielding requirements, fuel cycle requirements and some safety and environmental considerations. Conclusions resulting from the study are also presented.

21515 (CONF-791102—146) **Managing the fusion burn to improve symbiotic system performance.** Renier, J.P.; Martin, J.G. (Oak Ridge National Lab., TN (USA); Lowell Univ., MA (USA)). 1979. Contract W-7405-ENG-26. 10p. Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

Symbiotic power systems, in which fissile fuel is produced in fusion-powered factories and burned in thermal reactors characterized by high conversion ratios, constitute an interesting near-term fusion application. It is shown that the economic feasibility of such systems depend on adroit management of the fusion burn. The economics of symbiotes is complex: reprocessing and fabrication of the fusion reactor blankets are important components of the production cost of fissile fuel, but burning fissile material in the breeder blanket raises overall costs and lowers the support ratio. Analyses of factories which assume that the fusion power is constant during an irradiation cycle underestimate their potential. To illustrate the effect of adroit engineering of the fusion burn, this paper analyzes systems based on D-T and semi-catalyzed D-D fusion-powered U-233 breeders. To make the D-T symbiote self-sufficient, tritium is bred in separate lithium blankets designed so as to minimize overall costs. All blankets are assumed to have spherical geometry, with 85% closure. Neutronics depletion calculations were performed with a revised version of the discrete ordinates code XSDRN-PM, using multigroup (100 neutron, 21 gamma-ray groups) coupled cross-section libraries.

21516 (CONF-791103—93) **D-T and D-D cycles for fusion-powered U-233 factories.** Renier, J.P.; Martin, J.G. (Oak Ridge National Lab., TN (USA); Lowell Univ., MA (USA)). 1979. Contract W-7405-ENG-26. 7p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

In spite of a low reaction parameter, the semicatalyzed D-D cycle constitutes an interesting alternative for symbiotic systems because it eliminates the need for blanket tritium breeding. Previous work on D-D fusion-fission hybrids concluded that blanket energy multiplication is low and that this cycle may be of interest for ignited plasmas only. Here, it is shown that low multiplication does not penalize the symbiotic system.

21517 (DOE/ET/51010—6) **Conceptual design of a commercial tokamak hybrid reactor fueling system.** Matney, K.D.; Donnert, H.J.; Yang, T.F. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Fusion Power Systems Dept.). Dec 1979. Contract AC02-77ET51010. 57p. (WFPS-TME—79-032). Dep. NTIS, PC A04/MF A01.

A conceptual design of a fuel injection system for CTHR (Commercial Tokamak Hybrid Reactor) is discussed. Initially, relative merits of the cold-fueling concept are compared with those of the hot-fueling concept; that is, fueling where the electron is below 1 eV is compared with fueling where the electron temperature exceeds 100 eV. It is concluded that cold fueling seems to be somewhat more free of drawbacks than hot fueling. Possible implementation of the cold-fueling concept is exploited via frozen-pellet injection. Several methods of achieving frozen-pellet injection are discussed and the light-gas-gun approach is chosen from these possibilities. A modified version of the ORNL Neutral Gas Shielding Model is used to simulate the pellet injection process. From this simulation, the penetration-depth dependent velocity requirement is determined. Finally, with the velocity requirement known, a gas-pressure requirement for the proposed conceptual design is established. The cryogenic fuel-injection and fuel-handling systems are discussed. A possible way to implement the conceptual device is examined along with the attendant effects on the total system.

21518 (GA-A—15642) **Doublet III beamline: as-built.** Harder, C.R.; Holland, M.M.; Parker, J.W.; Guna, J.; Resnick, L. (General Atomic Co., San Diego, CA (USA); California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1980. Contract AT03-76ET51016. 10p. (CONF-791102—151). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

In order to fully exploit Doublet III capabilities and to study new plasma physics regimes, a Neutral Beam Injector System has been constructed. Initially, a two beamline system will supply 7 MW of heat to the plasma. The system is currently being expanded to inject ~ 20 MW of power (6 beamlines). Each beamline is equipped with two Lawrence Berkeley Laboratory type rectangular ion sources with 10 cm x 40 cm extraction grids. These sources will accelerate hydrogen ions to 80 keV, with extracted beam currents in excess of 80 A per source expected. The first completed source is currently being tested and conditioned on the High Voltage Test Stand at Lawrence Livermore Laboratory. This paper pictorially reviews the as-built Doublet III neutral beamline with emphasis on component relation and configuration relative to spatial and source imposed design constraints.

21519 (LBL—10367) **Trace identification of cesium and sodium in neutral beam research.** Ruby, L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jan 1980. Contract W-7405-ENG-48. 7p. (CONF-800607—18). Dep. NTIS, PC A02/MF A01.

From American Nuclear Society annual meeting; Las Vegas, NV, USA (8 Jun 1980).

Cesium and sodium in vapor form are used in two of the approaches to negative-ion production for neutral-beam research. Since fusion reactors are sensitive to the presence of high-Z impurities, it is important to monitor the extent to which the cesium and sodium migrate in the beam direction, or travel as part of the beam itself. Two techniques have been developed for the trace identification of either cesium or sodium on targets placed in vacuum. One of these involves neutron activation, and the other alpha-backscattering, to provide quantitative identification. Three types of targets have been employed, polyethylene which is suitable for the activation technique, beryllium which is useful for the alpha-backscatter analysis, and glassy carbon which is usable with either technique, and therefore, for cross comparison.

21520 (PPPL—1651) **Phased waveguide array with fixed tuning elements.** Motley, R.W.; Bernabei, S.; Hooke, W.M.; Paoloni, F.J. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Apr 1980. Contract EY-76-C-02-3073. 24p. Dep. NTIS, PC A02/MF A01.

The waveguide grill excites both penetrating lower hybrid waves and surface plasma waves. Quarter wavelength tuning elements attached to the sides of a twin waveguide are shown to reduce the surface wave component by a factor of ~ 3..

21521 (UCID—18542) **Beam loss by collimation in a neutralizer duct.** Hamilton, G.W.; Willmann, P.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Apr 1980. Contract W-7405-ENG-48. 14p. Dep. NTIS, PC A02/MF A01.

Beam fractions lost by collimation in a neutralizer duct are computed in x-x' phase space by using three examples of slab beam distributions under a broad range of duct dimensions, beam half-widths, and beam divergences. The results can be used to design compact neutralizers and to specify beam requirements. The computer code ILOST can be used under a broad range of beam conditions to compute the fraction lost by collimation.

21522 (UCRL—82984) **Startup of reversed-field mirror reactors using coaxial plasma guns.** Smith, A.C. Jr.; Hartman, C.W.; Carlson, G.A.; Neef, W.S. Jr.; Eddleman, J.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Nov 1979. Contract W-7405-ENG-48. 5p. (CONF-791102—137). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

Preliminary calculations are given that indicate that a coaxial plasma gun might scale reasonably to reactor-grade operating conditions. Ongoing experiments and numerical simulations should shed some light on the validity of the described scaling laws.

21523 (WFPS-TME—79-032) **Conceptual design of a commercial tokamak hybrid reactor fueling system.** Matney, K.D.; Donnert, H.J.; Yang, T.F. (Kansas State Univ., Manhattan (USA). Dept. of Nuclear Engineering; Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). Dec 1979. Contract EG-77-C-02-4231. 60p. Dep. NTIS, PC A04/MF A01.

A conceptual design of a fuel injection system for CTHR (Commercial Tokamak Hybrid Reactor) is discussed. Initially, relative merits of the cold-fueling concept are compared with those of the hot-fueling concept; that is, fueling where the electron temperature is below 1 eV is compared with fueling where the electron temperature exceeds 100 eV. It is concluded that cold fueling seems to be somewhat more free of drawbacks than hot fueling. Possible implementation of the cold-fueling concept is exploited via frozen-pellet injection. Several methods of achieving frozen-pellet injection are discussed and the light-gas-gun approach is chosen from these possibilities. A modified version of the ORNL Neutral Gas Shielding Model is used to simulate the pellet injection process. From this simulation, the penetration-depth dependent velocity requirement is determined. Finally, with the velocity requirement known, a gas-pressure requirement for the proposed conceptual design is established. The cryogenic fuel-injection and fuel-handling systems are discussed. A possible way to implement the conceptual device is examined along with the attendant effects on the total system.

21524 **Development and operation of computerized neutral beamline systems.** Stooksberry, R.W.; Rossmassler, J.E.; Katz, M. (Princeton Univ, NJ). *IEEE Trans. Nucl. Sci.*; NS-26: No. 4, 4623-4632(Aug 1979).

Neutral hydrogen beam injectors have been demonstrated to be effective in heating magnetically confined plasmas. A record ion temperature of 6.5 keV was achieved on the Princeton Large Torus

(PLT) with the aid of four injectors. Higher power injectors are being designed and fabricated for other devices including the Poloidal Divertor Experiment (PDX) and the Tokamak Fusion Test Reactor (TFTR). Dedicated minicomputer systems interfaced with CAMAC hardware are now operational on the four PLT neutral beam injectors as well as the neutral beam test stand. These systems provide data acquisition, archival, analysis, monitoring and control support. They illustrate many of the important considerations which relate to the future applications of this technology.

TRITIUM PROCESSING, ENVIRONMENT AND SAFETY

REFER ALSO TO CITATION(S) 21512, 21514

21525 (ANL—78-96) **Cryogenic distillation: a fuel enrichment system for near-term tokamak-type D-T fusion reactors.** Misra, B.; Davis, J.F. (Argonne National Lab., IL (USA)). Feb 1980. Contract W-31-109-ENG-38. 41p. Dep. NTIS, PC A03/MF A01.

The successful operation and economic viability of deuterium-tritium- (D-T-) fueled tokamak-type commercial power fusion reactors will depend to a large extent on the development of reliable tritium-containment and fuel-recycle systems. Of the many operating steps in the fuel recycle scheme, separation or enrichment of the isotropic species of hydrogen by cryogenic distillation is one of the most important. A parametric investigation was carried out to study the effects of the various operating conditions and the composition of the spent fuel on the degree of separation. A computer program was developed for the design and analysis of a system of interconnected distillation columns for isotopic separation such that the requirements of near-term D-T-fueled reactors are met. The analytical results show that a distillation cascade consisting of four columns is capable of reprocessing spent fuel varying over a wide range of compositions to yield reinjection-grade fuel with essentially unlimited D/T ratio.

INERTIAL CONFINEMENT TECHNOLOGY

REFER ALSO TO CITATION(S) 21011, 21380

21526 (COO—2218-153) **Conceptual innovations in hybrid reactors.** Greenspan, E.; Miley, G.H. (Illinois Univ., Urbana (USA). Fusion Studies Lab.). 1980. Contract EY-76-S-02-2218. 5p. (CONF-800446—1` Dep. NTIS, PC A02/MF A01.

From 2. international conference on emerging nuclear energy systems; Lausanne, Switzerland (8 Apr 1980).

A number of innovations in the conception of fusion-fission hybrid reactors, including the blanket, the fusion driver, the coupling of the fusion and the fission components as well as the application of hybrid reactors are described, and their feasibility assessed.

21527 (DOE/DP/40101—1) **Assessment of scaling laws and propagation windows for focussing of ion beams in fusion target chambers. Final report.** (JAYCOR, Alexandria, VA (USA)). Apr 1980. Contract AC08-79DP40101. 12p. Dep. NTIS, PC A02/MF A01.

Intense beams of multi-GeV high atomic weight ions are being actively investigated as possible ignitors for pellet fusion reactors. Beam transport models were developed for the final focussing of these beams in the reactor chamber, and investigated the role of microinstabilities, filamentation, conductivity, multiple scattering, and knockon electrons. Two propagation windows exist, namely the vacuum window at pressures below about 10^{-3} - 10^{-4} torr and a window around 1 torr. The 1 torr window (which is desirable from a reactor viewpoint) became less certain this year due to our discovery of the major role played by knock-on electrons which are sufficiently numerous to produce a reversed (ion-defocussing) magnetic field ahead of the ion pulse. Unless most of the knock-on current is wiped out by self-fields, this effect appears to eliminate use of self-pinched ion beams, and may degrade ballistic mode spot sizes as well. Intermediate energy knock-on electrons (0.3 ≦ v/sub z//V/sub b/ ≦ 1) may also dominate the electrical conductvity in the ion pulse, and will influence micro-instability and filamentation calculations.

21528 (DOE/ER/10459—3) **Inter-subband optical absorption in an inversion layer on a semiconductor surface in tilted magnetic fields. Progress report, July 1, 1979-June 30, 1980.** O'Connell, R.F. (Louisiana State Univ., Baton Rouge (USA). Dept. of Physics and Astronomy). 1980. Contract AS05-79ER10459. 8p. Dep. NTIS, PC A02/MF A01.

In a magnetic field tilted with respect to the surface of Si, Beinvogl and Koch observed combined resonance transitions, resulting from a coupling of Landau levels and subband states, in an accumulation layer on n-type (100) Si. Because of some unexplained features in the observations, we have analyzed what one should expect on theoretical grounds. As a result of both analytic and numerical calculations, it is concluded that there are still unexplained discrepancies between theory and experiment. The absorption of radiation in a magnetoplasma was studied and the results were applied to the laser fusion process.

21529 (KMSF-U—904) **Measurements of short-pulse backscatter from a gas target.** Mayer, F.J.; Busch, G.E.; Kinzer, C.M.; Estabrook, K.G. (KMS Fusion, Inc., Ann Arbor, MI (USA); California Univ., Livermore (USA). Lawrence Livermore Lab.). 1979. Contract W-7405-ENG-48;AC08-78DP40030. 16p. (CONF-790564—2). Dep. NTIS, PC A02/MF A01.

From 9. annual conference on anomalous absorption of electromagnetic waves; Rochester, NY, USA (15 May 1979).

Measurements are reported of short-pulse (100 psec), 1.06 μm laser backscatter from a high pressure nitrogen gas target. Spectral measurements clearly show the expected Brillouin red shift. The backscatter fraction saturated at ~ 40% at 2 x 10^{15} W/cm^2 and we have observed what appears to be multiple Brillouin scattering in a long gradient length plasma.

21530 (KMSF-U—905) **Recent inertial confinement fusion experiments.** Johnson, R.R. (KMS Fusion, Inc., Ann Arbor, MI (USA)). 1979. Contract AC08-78DP40030. 20p. Dep. NTIS, PC A02/MF A01.

The American Laboratories which have conducted laser interaction experiments and are included in this report are KMS Fusion, Inc. (KMSF), Los Alamos Scientific Laboratory (LASL), Laboratory for Laser Energetics (LLE), Lawrence Livermore Laboratory (LLL), and Naval Research Laboratory (NRL). Although information on all aspects of every experimental laboratory is not readily available, it is still possible to define certain experimental areas which are general enough to provide certain commonality between the laboratories. A review is given.

21531 (KMSF-U—951) **Laser fusion experiments at KMS Fusion, Inc.** Gomberg, H.J. (KMS Fusion, Inc., Ann Arbor, MI (USA)). 1979. Contract AC08-78DP40030. 31p. (CONF-791238—1). Dep. NTIS, PC A03/MF A01.

From 13. European conference on laser interaction with matter; Leipzig, German Democratic Republic (10 Dec 1979).

The laser fusion program at KMS Fusion has been directed toward achieving high density compressions. The limitations in this endeavor have been caused by the small amount of energy which is deposited in the fuel before the implosion occurs. This preheat energy is associated with radiative transport from the conduction front and with the athermal conditions existing in the corona which allows a portion of the high energy electron distribution to penetrate through the target. Targets have been designed and tested which minimize the effect of the electron preheat but since they increase the mass of the target they penalize the laser fusion experiment by requiring much larger laser drivers. The approach taken by KMS Fusion is to attempt to minimize the source of the electron preheat through broadening of the laser bandwidth and operating at shorter wavelengths.

21532 (LA—7715-MS) **Anomalous intense driver (AID) concept.** Thode, L.E. (Los Alamos Scientific Lab., NM (USA)). Mar 1980. Contract W-7405-ENG-36. 57p. Dep. NTIS, PC A04/MF A01.

An optimized electron bunching mechanism is utilized to efficiently couple the energy of a 5 to 100 MeV, 1 to 30 TW electron beam into a 3 to 50 cm^3 plasma of electron density 10^{17} to 10^{20} cm^{-3}. An efficient coupling of beam energy and momentum to the plasma is possible due to the relativistic nature of the beam dynamics combined with the short wavelength of the bunching mechanism in a high-density plasma. The rapidly produced multi-kilovolt plasma can be used directly to develop a pulsed neutron and x-ray source. Alternatively, the plasma can be used to drive a hierarchy of inertial confinement or x-ray devices. Utilizing this novel concept, controlled thermonuclear fusion may be achievable within present or near term relativistic electron beam technology.

21533 (LA—8207-MS) **Report of the heavy-ion fusion task group.** Sawyer, G.A.; Booth, L.A.; Henderson, D.B.; Jameson, R.A.; Kindel, J.M.; Knapp, E.A.; Pollock, R.; Talbert, W.L.; Thode, L.E.; Williams, J.M. (Los Alamos Scientific Lab., NM (USA)). Feb 1980. Contract W-7405-ENG-36. 33p. Dep. NTIS, PC A03/MF A01.

An assessment of heavy-ion fusion has been completed. Energetic heavy ions, for example 10-GeV uranium, provided by an rf linac or an induction linac, are used as alternatives to laser light to drive inertial confinement fusion pellets. The assessment has covered accelerator technology, transport of heavy-ion beams, target interaction physics, civilian power issues, and military applications. It is concluded that particle accelerators promise to be efficient pellet drivers, but that there are formidable technical problems to be solved. It is recommended that a moderate level research program on heavy-ion fusion be pursued and that LASL should continue to work on critical issues in accelerator development, beam transport, reactor systems studies, and target physics over the next few years.

21534 (MSNWP—1097-1099) **Development of rare gas excimer photolytic drivers. Draft final report.** (Mathematical Sciences North-

west, Inc., Bellevue, WA (USA)). 31 Dec 1979. Contract AC05-78DP40038. 224p. Dep. NTIS, PC A10/MF A01.

Portions of document are illegible.

This final report summarizes the deveopment of the Xe_2 rare gas excimer laser. The basic objective of the present program was to investigate whether or not the photolytically pumped Group VI lasers have the potential of being scaled as reactor drivers for the inertial confinement fusion program. The specific goals of the program were: (1) development of a detailed kinetic model for the e-beam pumped rare gas excimer laser; (2) experimental measurement of the fluorescence and laser performance for comparison and verification of the kinetic model; and (3) the use of the kinetic model to optimize the conceptual design of a 10 kilojoule excimer laser.

21535 (NRL-Memo—4192) **Numerical study of optical ray retracing in laser-plasma backscatter.** Lehmberg, R.H.; Holder, K.A. (Naval Research Lab., Washington, DC (USA)). 1 Apr 1980. Contract ES-77-A-01-6021. 51p. Dep. NTIS, PC A04/MF A01.

Optical ray retracing in stimulated Brillouin backscatter from laser-produced plasmas is studied numerically, using a 2-D propagation code (BOUNCE). This code treats steady state behavior in the strong damping limit, and includes self focusing effects. Ray retracing phenomena are grouped into two limiting cases. In the whole beam limit, the pump field at the lens has a broad spatial profile that can be focused to a long narrow waist within the plasma. This geometry selectively amplifies only those initial noise components that are propagating back along the axis, where the net gain is highest. The simulations show that such effects exhibit a pronounced threshold due to self focusing, and disappear when the focal width becomes comparable to the length of the gain medium. In the opposite limit, where the pump radiation at the lens is dominated by small scale transverse structure, the backscatter can reproduce this structure in detail (i.e., exhibit wavefront reversal) when the far field of the pump produces an interference pattern in the plasma.

21536 (UCRL—84002) **Laser fusion experiments, facilities and diagnostics at Lawrence Livermore Laboratory.** Ahlstrom, H.G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Feb 1980. Contract W-7405-ENG-48. 96p. (CONF-800208—12). Dep. NTIS, PC A05/MF A01.

From Tropical meeting on inertial confinement fusion; San Diego, CA, USA (26 Feb 1980).

The progress of the LLL Laser Fusion Program to achieve high gain thermonuclear micro-explosions is discussed. Many experiments have been successfully performed and diagnosed using the large complex, 10-beam, 30 TW Shiva laser system. A 400 kJ design of the 20-beam Nova laser has been completed. The construction of the first phase of this facility has begun. New diagnostic instruments are described which provide one with new and improved resolution, information on laser absorption and scattering, thermal energy flow, suprathermal electrons and their effects, and final fuel conditions. Measurements were made on the absorption and Brillouin scattering for target irradiations at both 1.064 μm and 532 nm. These measurements confirm the expected increased absorption and reduced scattering at the shorter wavelength. Implosion experiments have been performed which have produced final fuel densities over the range of 10x to 100x liquid DT density.

21537 (UCRL—84258) **Development of construction specifications to attain clean rooms for the NOVA laser facility.** Benedix, C.P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Feb 1980. Contract W-7405-ENG-48. 21p. (CONF-800517—3). Dep. NTIS, PC A02/MF A01.

From 26. annual technical meeting of the Institute for Environmental Sciences; Philadelphia, PA, USA (11 May 1980).

This paper describes the process of defining technical requirements for a major Department of Energy Research and Development Facility and subsequent development of construction specifications for the clean spaces in that facility. The organizational interactions between technical client, Engineering and Construction elements are described. The importance of an interdisciplinary team approach is stressed. A brief description of the SHIVA Laser and NOVA Laser Clean Spaces is included to indicate the scope of the facility undertaking. A number of potential pitfalls are discussed that may be helpful to designers of new facilities.

21538 (UCRL-Trans—11572) **Computer simulation of laser implosive compression of a DT target and analytic solutions of the shock waves and thermal waves.** Weihan, T. Translated from *Wu Li Hsueh Pao;* **29**: No. 3, 364-376(May 1979). 33p. Dep. NTIS, PC A03/MF A01.

On the basis of an analysis of the results of a computer simulation of two-temperature laser implosive compression of a DT target, the author has found analytic solutions for the shock waves and thermal waves which basically agree with the computer simulation results.

21539 **Status of inertial confinement fusion.** Stickley, C.M. (US DOE). *Energy Technol. (Wash., D.C.);* **6**: 871-877(1979).

From 6. energy technology conference and exposition; Washington, DC, USA (26 Feb 1979).

By the early 1970's sufficiently powerful lasers were available to cause measurable fusion energy release from laser-driven fuel pellets. The energy release time is so brief, being shorter than the disassembly time of the pellet, that only the inertia of matter is required to confine the pellet and fuel in the plasma state. Rapid progress has been made in the development of fusion drivers, target physics understanding and target chamber design thus making it possible for the Department of Energy to project with some confidence the operation of a prototype fusion energy facility near the end of the century. A review is presented of this progress and other aspects of the inertial confinement fusion (ICF) program. It is concluded that inertial confinement fusion has an impressive record of achievements to date especially in view of the budgetary support it has achieved. It has important, low risk applications to program. weapons technology and extremely important but higher risk energy applications. It also has significant technical advantages when used for fusion energy.

COMPONENT DEVELOPMENT AND MATERIALS TESTING

REFER ALSO TO CITATION(S) 20909, 20910, 20914, 20915, 21513

GENERAL AND MISCELLANEOUS

MANAGEMENT

21540 (CONF-791103—89) **Scientometric study of IAEA activation analysis conferences.** Lyon, W.S. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 6p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

Multiple speakers at three IAEA conferences on NAA in Life Sciences are analyzed and compared with other conferences; results indicate that these NAA conferences are about as open for participation as any of the other conferences. (DLC)

21541 (DOE/EIA—0149(79)) **EIA Publications Directory: a user's guide.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Feb 1980. 161p. Dep. NTIS, PC A08/MF A01.

This is the second edition of the Energy Information Administration's directory of publications. It contains descriptions of 361 periodical reports and one-time publications, a list of survey forms, and information on microfiche files and data tapes. The publications are those published by EIA from its inception in 1977 through December 31, 1979. They are categorized as follows: EIA programs and products; coal and coal products; petroleum; natural gas; hydro energy; solar energy; wind energy; electric power; energy analysis and modeling; energy conservation, consumption, and utilization; environmental sciences, atmospheric; and general and miscellaneous. Each abstract specifies what data the publication covers, how those data are presented, how often the publication is issued, the report number, availability, and the cost, if any. A comprehensive subject index, a report number index, a title index, and information about how to order are included.

21542 (DOE/EIA—0149(79Flyer)) **EIA publications.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Feb 1980. 47p. Dep. NTIS, PC A03/MF A01.

The Energy Information Administration (EIA) is the federal agency responsible for collecting and disseminating energy data and information. EIA evaluates, assemoles, and analyzes energy data on production, disposition, resources, technology, and related economic and statistical information. Its comprehensive publications program ranges from primary statistics to short-term, midterm, and long-term projections of the Nation's energy needs. This brochure lists all EIA publications issued since the inception of EIA within the Department of Energy on October 1, 1977. Included are over 350 analysis, technical, model documentation, contractor, and special-purpose one-time reports; maps; and periodicals. The publications are categorized as follows: EIA programs and products; coal and coal products; petroleum; natural gas; hydro energy; solar energy; wind energy; electric power; energy analysis and modeling; energy conservation, consumption, utilization; environmental sciences, atmospheric; and general and miscellaneous (RWR)

21543 (ORAU—166) **Fields versus occupations: a comparison of NSF data on scientific and technical fields with data on occupation.** Finn, M.G. (Oak Ridge Associated Universities, Inc., TN (USA)). Mar 1980. Contract EY-76-C-05-0033. 53p. Dep. NTIS, PC A04/MF A01.

The National Science Foundation (NSF) introduced a new manpower classification procedure starting with the publication of data from the 1972 Postcensal Manpower Survey (PMS). This classification procedure differs from previous procedures in that multiple criteria, based on information on the respondent's education, occupation, and professional self-identification, determine whether the respondent is assigned to a field of science or engineering. In an effort to show how and why data classified on the basis of the new NSF procedure differ from more familiar occupational data, this project compares tabulations of the 1972 PMS data classified on the basis of each of the two procedures. The major findings of this comparison are as follows: The degree of overlap between sets of persons defined in these two different ways varies greatly by field. The educational attainment of engineers and of some of the scientist categories is substantially higher when the NSF classification is used instead of the occupational classification. For the other statistics examined, the choice of classification scheme makes little difference. A secondary project purpose was to test the sensitivity of the NSF data to an alternative treatment of item nonresponse. This alternative treatment produced an increase of 10.9 percent in the total count of persons classified as scientists or engineers according to the NSF criteria. There was, however, no evidence that the descriptive statistics reported by NSF were substantially biased as a result of the way in which item nonresponse was treated by NSF. The report concludes with some recommendations for the design of the 1982 postcensal survey. 2 figures, 17 tables.

MATHEMATICS AND COMPUTERS

REFER ALSO TO CITATION(S) 21055, 21108

21544 (CONF-800201—7) **Towards sensible floating-point arithmetic.** Cody, W.J. (Argonne National Lab., IL (USA)). 1980. Contract W-31-109-ENG-38. 8p. Dep. NTIS, PC A02/MF A01.

From COMPCON 1980; San Francisco, CA, USA (25 Feb 1980).

Efforts to promote the development of high-quality transportable numerical software show that few, if any, of the floating-point arithmetic systems in existing computers are completely satisfactory for serious numerical computation. Examination of the defects in these systems leads to specifications for a sensible floating-point system from a numerical analyst's viewpoint. 1 table.

21545 **Quadratic recurrence rule of Faltung type.** Stein, P.R.; Everett, C.J. (Los Alamos Scientific Lab., NM). *J. Comb., Inf. Syst. Sci.;* **3**: No. 1, 1-10(1978).

For fixed $b \geq 0$, the numbers S/sub n/(b) are defined by $S_1 = 1$, S/sub n+1/ = (n + b)(S$_1$S/sub n/ + S$_2$S/sub n-1/...+ S/sub n/S$_1$), $n \geq 1$. It is shown that the log-convexity of the S/sub n/, i.e., S/sub n+2/S/sub n/ > S/sub n+1/^{2}, implies the existence of lim/sub n $\rightarrow \infty$/S/sub n/(b)/(2n - 1 + 3b)(2n -3 + 3b)...(1 + 3b). (For b = 0, it was proved earlier that this limit is in fact 1/e.) For arbitrary $b \geq 0$, the log-convexity remains an open question, although it is established here for the values b = 0, .2, .4, ..., 9.8, 10. The numbers U/sub n/ defined by $U_1 = 1$, U/sub n+1/ = = (An + B)(U$_1$U/sub n/ + U$_2$U/sub n-1/ + ...+ U/sub n/U$_1$), A > 0, $B \geq 0$, can be reduced to an S/sub n/(b) sequence, with b = B/A, by an obvious scaling, and the existence of a corresponding limit can be inferred from that of the limit above. 1 table.

21546 (DOE/EY/22874—64) **Extensions of linear discriminant analysis for statistical classification of remotely sensed satellite imagery. Technical report No. 30.** Switzer, P. (Stanford Univ., CA (USA)). Nov 1979. Contract EY-76-S-02-2874. 20p. Dep. NTIS, PC A02/MF A01.

Linear discriminant analysis is a commonly used statistical tool for classification of surface features using satellite surface reflectance data. Extensions of this basic tool promise substantial improvements. In particular, the added effectiveness of integration of spatial autocorrelation into the discriminant model, resolution of nonhomogeneous pixels, and data based prior probability estimates of class membership, and the use of unclassified pixels as part of the discriminant function training set are examined.

21547 (KMSF-U—969) **BASIC Plus-2 taskbuild optimization on RSX-11M.** Downward, J.G. (KMS Fusion, Inc., Ann Arbor, MI (USA)). 1980. Contract AC08-78DP40030. 5p. (CONF-800414—2). Dep. NTIS, PC A02/MF A01.

From DECUS spring symposium; Chicago, IL, USA (22 Apr 1980).

The long times required for taskbuilding BASIC Plus-2 tasks are found by many to be a deterrent to using the BASIC Plus-2 compiler on RSX11M. In the course of implementing a BASIC Plus-2 project, techniques that dramatically reduce taskbuild times were developed. These techniques include optimizing RMS11 ODL structures for fast taskbuilding, installing RMS11 and BASIC Plus-2 resident libraries on the fly for program testing, and building small BASIC Plus-2 tasks without any RMS11 overlays. In some cases 200 to 300% improvements in taskbuild speed are observed. Suggestions for optimal use of BASIC Plus-2 as a compiler are also presented.

21548 (SAND—80-0197) **Least squares fitting of discrete data by polynomials in several variables.** Hanson, R.J. (Sandia Labs., Albuquerque, NM (USA)). Apr 1980. Contract EY-76-C-04-0789. 14p. Dep. NTIS, PC A02/MF A01.

The problem of least-squares fitting k-dimensional data by polynomials is considered. This polynomial is represented as a linear combination of products of one-dimensional Chebyschev polynomials. Suggestions about a numbering or subscripting convention are given as well as a review of appropriate solution methods for the resulting (large) least squares system.

21549 (UCID—18506) **Use of a General Nonlinear Least-Squares Curve Fitting Program with nonclosed form relationships.** Abey, A.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 26 Dec 1979. Contract W-7405-ENG-48. 23p. Dep. NTIS, PC A02/MF A01.

A use for GNLS, a general nonlinear least-squares curve fitting program, is presented. In this use GNLS determines a set of best parameters for relationships that cannot be written in closed form. This program can be useful for experimenters who need to determine experimental parameters by fitting nonclosed-form relationships to experimental data. Two examples are given to indicate how GNLS can be used for this type of problem. 11 figures.

21550 (UCRL—84102) **GEARS: a package for the solution of sparse, stiff ordinary differential equations.** Sherman, A.H.; Hindmarsh, A.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Mar 1980. Contract W-7405-ENG-48. 12p. (CONF-800334—1). Dep. NTIS, PC A02/MF A01.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

This paper describes GEARS, a package of Fortran subroutines designed to solve stiff systems of ordinary differential equations of the form dy/dt = f(y,t), where the Jacobian matrices J = ∂ f/∂ y are large and sparse. The integrator is based on the stiffly stable methods due to Gear, and this approach leads to a sparse system of nonlinear equations at each time step. These are solved with a modified Newton iteration, using one of two separate sparse matrix packages to solve the sparse linear equations that arise. This paper describes the package, in some detail, discusses a number of issues that affected the design of the package, and presents a numerical example to illustrate the effectiveness of the package. 1 figure, 1 table.

21551 **Incremental compiler for data acquisition.** Taff, L.M.; Sporrel, F. (Fermi Natl Accel Lab, Batavia, Ill). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 4, 4500-4504(Aug 1979).

Computer software is described which incrementally compiles threaded code for pulse-height analysis according to console keyboard commands. This technique allows a single program to adapt to many experimental situations of arbitrary complexity, and to be changed during an experiment. Details of the "data acquisition processor" are discussed. Some shortcomings of the program in which this routine is embedded, mainly in the realm of user interaction are outlined. Suggestions are made for future work to avoid past problems.

21552 **Data analysis at LAMPF: a hierarchical approach.** Perry, D.G.; Sparks, D.C. (Los Alamos Sci Lab, NM). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 4, 4572-4579(Aug 1979).

The development of data analysis at LAMPF has evolved to provide a hierarchy of data-analysis capability. This capability ranges from data-acquisition computers (when not in use for data acquisition) through large minicomputer and super minicomputers to large computers such as the CDC-7600 or CRAY-1. This hierarchy of capability allows one to analyze data in the most cost-effective manner. The connection to the LASL Central Computing Facility (CCF) will be through XNET, an extended network linking remote sites to the CCF. XNET, along with a proposed local network, is described.

21553 **Specialized, multi-user computer facility for the high-speed, interactive processing of experimental data.** Maples, C.C. (Univ of Calif, Lawrence Berkeley Lab). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 4, 4580-4587(Aug 1979).

A proposal has been made to develop a specialized computer facility specifically designed to deal with the problems associated with the reduction and analysis of experimental data. Such a facility would provide a highly interactive, graphics-oriented, multi-user environment capable of handling relatively large data bases for each user. By conceptually separating the general problem of data analysis into two parts, cyclic batch calculations and real-time interaction, a multi-level, parallel processing framework may be used to achieve high-speed data processing. In principle such a system should be able to process a mag tape equivalent of data, through typical transforma-

tions and correlations, in under 30 sec. The throughput for such a facility, assuming five users simultaneously reducing data, is estimated to be 2 to 3 times greater than is possible, for example, on a CDC7600.

21554 Models of hierarchical machine support. Berry, D.M. (Univ. of California, Los Angeles); Erlinger, M.; Johnson, J.B.; von Staa, A. pp 557-588 of Formal descriptions of programming concepts. Neuhold, E.J. (ed.). Amsterdam, Netherlands; North-Holland Publishing Co. (1978).

In a multilevel, hierarchically designed and implemented operating system, there are several methods for supporting the abstract machine at any level: interpretation, enmasterization, virtualization, compilation, and software extension. Examples of each method are presented, and a framework for characterizing any method as a pair of information structure models and mappings between them is described. The framework is used to describe three of the methods and their examples. In conclusion, a view of an entire system as a possible multipeaked tower of such models is given. 25 figures.

21555 k-minimally n-edge-connected graphs. Maurer, S.B. (Princeton Univ., NJ); Slater, P.J. Contract AT(29-1)-789. *Discrete Math.;* **24**: 185-195(1978).

A graph is k-minimal with respect to some parameter if the removal of any j edges, $j \leq k$, reduces the value of that parameter by j. For $k = 1$ this concept is well-known; multiple minimality, that is, $k \geq 2$, is considered here. All graphs that are multiply minimal with respect to connectivity or edge-connectivity are characterized. It is also shown that there are essentially no digraphs that are multiply minimal with respect to diconnectivity or edge-diconnectivity. In addition, basic properties and multiple minimality are investigated for a variant of edge-connectivity. 1 figure.

INFORMATION HANDLING

REFER ALSO TO CITATION(S) 20174, 20734, 20737, 21149, 21163, 21234, 21254

21556 (BNL—51109) **Compatibility of DOE energy data bases with EEMIS data requirements.** D'Acierno, J.; Hermelee, A. (Brookhaven National Lab., Upton, NY (USA)). Dec 1979. Contract EY-76-C-02-0016. 69p. Dep. NTIS, PC A04/MF A01.

Object of this report is to present the data from EIA data bases which are compatible with the requirements of the data structure for the Energy Emergency Management Information System (EEMIS). An overview of data availability is briefly described and presented in the EEMIS petroleum and natural gas flow diagrams as well as in a more detailed review with each data element in the EEMIS data requirements. This information is presented with the intent that it be used as an overall system guide during the data transfer task as well as in future operation of EEMIS and in the interpretation of EEMIS data.

21557 (DOE/IR/02849—2) **Report of activities for the period of January 1-December 31, 1979.** (National Academy of Sciences - National Research Council, Washington, DC (USA)). 1979. Contract EY-76-C-02-2849. 14p. Dep. NTIS, PC A02/MF A01.

Activities and accomplishments of CODATA are sketched. They include meeting preparation, a directory of data sources for science and technology, the book Data Handling for Science and Technology - an Overview and Sourcebook, and other publications. (RWR)

21558 (DOE/TIC—4602) **Energy Information Data Base: DECOL manual (Descriptive Cataloging On-Line).** (Department of Energy, Oak Ridge, TN (USA). Technical Information Center). Jan 1980. 247p. Dep. NTIS, PC A11/MF A01.

The DOE Technical Information Center (TIC) is responsible for creating bibliographic data bases that are used in the announcement and retrieval of publications of all types dealing with all phases of energy. This manual tells how data are initially entered into the TIC interactive processing system, and describes in detail the data elements and types of items included in the data bases. 21 tables. (RWR)

21559 (SAND—80-0556C) **Secure communications in the presence of pervasive deceit.** Simmons, G.J. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 10p. (CONF-800448—1). Dep. NTIS, PC A02/MF A01.

From IEEE symposium on computer privacy and security; Oakland, CA, USA (14 Apr 1980).

The functions of secrecy, identification of the transmitter and of authentication of messages, and combinations of these, are in principle all achievable with either symmetric or asymmetric cryptosystems. Since secure communications depend on authenticated data exchanges between and/or authenticated actions by some of the parties to the communication, the fundamentals of authentication using symmetric or asymmetric techniques are developed. The surprising conclusion is that they differ only in the secure exchanges required to achieve further secure communications. The problem of authenticating a public-key directory is discussed in the light of these findings.

21560 (UCRL—84076) **Television as an employee communication tool at LLL.** Saunders, J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 Mar 1980. Contract W-7405-ENG-48. 15p. (CONF-800509—2). Dep. NTIS, PC A02/MF A01.

From 27. international technical communication conference; Bloomington, MN, USA (14 May 1980).

Television's great strength as a news medium is its ability to bring a story to life. Like no other medium, TV can bridge the gap between a fact and its fuller significance. On the other hand, TV has a disturbing potential to dominate viewers. It communicates in split-second images narrated in rapidly spoken words that cannot be examined. The show rolls on, with or without the puzzled viewer, whose tendency, therefore, is to acquiesce in an assertion's plausibility. Thus, the trick in organizational television, which is communication with a purpose, is to insist that the goal be to convey information, not to maximize ratings with the techniques of electronic hypnotism. The Lawrence Livermore Laboratory's televised news magazine for employees, Video Journal, has an especially demanding audience. It is heavily loaded with professionals and those with a professional-level interest in technology. The LLL audience also tends to be sour on the news media, the Laboratory having been the subject of much inaccurate news coverage in recent years. Research suggests that television may be the medium best received by an audience that is suspicious of the news media generally. Writing news for a television audience is like writing news for a newspaper - but more so. Because the viewer must catch all TV news the first time through, the cardinal rules of newswriting - tight construction and focused organization - are even more important in television than in print. Copy must be geared and timed to the visual material. Numbers, unfamiliar names and complex subjects should be avoided. Finally, the subject should be one that TV can serve - an alive, animate subject.

21561 Design and evaluation of a vocabulary switching system for use in multi-base search environments. Final report. Niehoff, R.; Kwasny, S.; Walker, A.; Wessells, M. Columbus, OH; Battelle Columbus Laboratories (1980). 176p. (NP—24399). National Science Foundation, Division of Information Science and Technology, Washington, DC.

The Vocabulary Switching System (VSS) described in this report specifically addresses the problem of heterogeneous data base vocabularies and indexes, and how these differences can be neutralized to facilitate multi-base switching. VSS is an experimental, on-line, automated subject switching system. The system produces semantic, syntactic, and generic relatives to search terms supplied by the user because it is a system based on the linguistic structures of existing thesauri or controlled vocabularies. The performance of 29 experimental stacks was evaluated with the aid of three useful measures, coverage, precision, and speed. Several stacks showed promise for becoming an optimal switching strategy, that is, a strategy with the combined qualities of high precision and broad coverage. Results from term level analyses suggest that an optimal strategy could contain word and stem options, but the placement of these options within an overall strategy is critical. Initial attempts to evaluate VSS with the aid of an actual retrieval experiment were encouraging but inclusive. The results support observations that no single data base is an authorative source for information sought and significantly higher recall is possible when multi-base searching is employed. A nationwide on-line user survey was undertaken. It provides a concise anatomy of searching habits and preferences in today's world of on-line information retrieval. 26 figures, 32 tables.

CIVILIAN DEFENSE

21562 (AD-A—072388) **Distributed, survivable direction and control systems for civil preparedness -- concepts and initial designs. Final report.** Rosenthal, M.; Farr, L. (Rosenthal-Farr and Associates, Los Angeles, CA (USA)). 19 May 1979. Contract DCPA01-78-C-0232. 215p. NTIS PC A10/MF A01.

The purpose of this study was to develop concepts and initial designs for distributed, survivable direction and control systems for civil preparedness in the mid-1980 time period. The study was organized into the following tasks: (1) evaluate the effectiveness of existing operational concepts of direction and control, and develop revised concepts, (2) review the state-of-the-art of command, control, and communications in the U.S. Department of Defense, and evaluate its applicability to direction and control, (3) develop alternative configurations for survivable direction and control, and (4) evaluate the cost-effectiveness of these alternatives. In this study, direction and control is defined to consist of the following functions: (1) decision making, coordination, and resource allocation, (2) emer-

gency operations reporting, (3) warning, (4) emergency public information, (5) damage assessment and radiological defense, and (6) communications. The project concluded that existing operational concepts, procedures, and equipment components, especially long-range communications, were unlikely to result in survivable direction and control in the 1980s threat environment. Revised concepts of operation are suggested, and new, more survivable communications techniques are described including: packet radio communications, and meteor burst communications.

21563 (AD-A—073038) **Warning system re-evaluation and local government guidance update. Final report.** Driscoll, C.R.; Bethel, C.D. Jr; Bertsch, C.J. (Computer Sciences Corp., Falls Church, VA (USA)). 7 Aug 1979. Contract DCPA01-78-C-0229. 206p. NTIS, PC A10/MF A01.

This report presents the results of an evaluation of the capability of the current national warning system to alert and warn Federal, state, and local officials and also the general public in the event of an impending or actual attack on the nation. The study also considered warnings required due to natural disasters or man caused events. Alternative alerting and warning systems, old and new, were evaluated. A detailed report on facilities supporting the State of Colorado, the Colorado Springs (Risk Area) and the Fremont County (Host Area) are included. The report provides conclusions on system weaknesses and recommended actions for developing an improved system. Also included as appendices are State and local warning plans and a warning plan guide addressing crisis relocation planning.

21564 (AD-A—073102) **Post-test analysis of Brunswick MOD-shelter tested in Dice Throw. Technical report.** Calligeros, J.M. (Mitre Corp., Bedford, MA (USA)). Jul 1979. Contract F19628-79-C-0001. 78p. NTIS, PC A05/MF A01.

A post-test examination and structural failure analysis of the Brunswick MOD shelter exposed to a 6.5 psi incident overpressure in the 1976 Dice Throw high explosive (HE) field test is presented. The shelter is of modular construction incorporating WR II-3/8-3.8 kraft paper honeycomb for the wall-panel core material. Shock-mounted equipment racks were located near the roadside and curbside walls. The design of the shelter was intended to withstand the blast loads and has some features that have been proposed for the GLCM communciations shelter. A detailed examination of the MOD shelter and of wall-panel sections was made. The overall condition of the shelter and the structural failure modes of the panels are described, and some recommendations for GLCM application are given.

21565 (ORNL—5541) **Blast tests of expedient shelters in the Misers Bluff event. Final report, February 1978-January 1980.** Kearny, C.H.; Chester, C.V.; York, E.N. (Oak Ridge National Lab., TN (USA)). Jan 1980. Contract W-7405-ENG-26. 127p. Dep. NTIS, PC A07/MF A01.

Expedient shelters were blast-tested by a conventional explosion equivalent to a 0.2 KT nuclear explosion. The estimated survivabilities in a large nuclear explosion are: (1) improved Small-Pole Shelter, 345 kPa (50 psi); (228) triangular entryway and blastdoor made of poles, 173 kPa (25 psi); (3) Chinese A-Frame Pole Shelter, 48 kPa (7 psi); and (4) lightly shored Pole-Covered Trench Shelters, 103 kPa (15 psi).

CORPORATE INDEX

In the Corporate Index, report literature is indexed using the name of the organization or institution responsible for issuing the report. Headings are provided for all report literature and for published literature for which a corporate approach is especially desirable, e.g., symposium and conference proceedings.

Each entry under a corporate heading gives the report title and the volume and abstract numbers. Report numbers, if applicable, are given in parentheses at the end of the entry.

DOE Energy Information Data Base: Corporate Author Entries (TID-4585) is used in the standardization of corporate entries. TID-4585 is available for purchase from the National Technical Information Service (NTIS), U. S. Department of Commerce, Springfield, Virginia 22161.

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Closed Brayton cycle advanced central receiver solar-electric power system. Volume 1: executive summary. Final report, 5:20339 (SAN—1726-1(Vol.1))

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The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processes applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept. (e.g. Pipeline Quality Gas see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed.

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EC-77-A-31-1034	Grumman Aerospace Corp., Bethpage, NY (USA)	
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EC-77-A-31-1040	National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center	
	5:20852	DOE/NASA/1040—80/10
EC-77-C-03-1470	Dynatrend, Inc., Arlington, VA (USA)	
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EC-77-S-02-4206	Purdue Univ., Lafayette, IN (USA). Energy Systems Simulation Lab.	
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EF-76-C-01-2514	Lummus Co., Bloomfield, NJ (USA)	
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EF-77-A-01-2570	Pike County Coal Gasification Project, Pikeville, KY (USA)	
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EF-77-A-01-2593	National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center	
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EF-77-C-01-1207	Bituminous Coal Research, Inc., Monroeville, PA (USA)	
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EF-77-C-01-2012	Illinois Coal Gasification Group, Chicago (USA)	
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EF-77-C-01-2468-012	Engineering Societies Commission on Energy, Inc., Washington, DC (USA)	
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EF-77-C-01-2468-016	Engineering Societies Commission on Energy, Inc., Washington, DC (USA)	
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EF-77-C-01-2612	Rockwell International Corp., Canoga Park, CA (USA). Rocketdyne Div.	
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EF-77-G-01-2756	Georgia Inst. of Tech., Atlanta (USA). School of Civil Engineering	
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EF-77-S-01-2702	Worcester Polytechnic Inst., MA (USA)	
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EF-77-S-01-2710	Pennsylvania State Univ., University Park (USA). Dept. of Chemistry	
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EF-77-S-01-2762	Princeton Univ., NJ (USA). Dept. of Mechanical and Aerospace Engineering	
	5:20031	FE—2762-8
EG-77-A-01-4071	City of Huntsville, AL (USA)	
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EG-77-A-01-4079	Mueller Associates, Inc., Baltimore, MD (USA)	
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EG-77-A-03-1510	Mueller Associates, Inc., Baltimore, MD (USA)	
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EG-77-C-01-4949	International Business Machines Corp., Huntsville, AL (USA). Federal Systems Div.	
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EG-77-C-02-4231	Columbia Univ., New York (USA). Dept. of Applied Physics and Nuclear Engineering	
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EG-77-C-03-1591	AiResearch Mfg. Co., Torrance, CA (USA)	
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EG-77-S-02-4182	Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center	
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EG-77-S-02-4254	Northwestern Univ., Evanston, IL (USA)	
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EG-77-S-02-4380	Boston Univ., MA (USA). Dept. of Chemistry	
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EG-77-S-02-4385	Notre Dame Univ., IN (USA). Dept. of Metallurgical Engineering and Materials Science	
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EG-77-S-02-4459	Carnegie-Mellon Univ., Pittsburgh, PA (USA)	
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EG-77-S-02-4520	Colorado State Univ., Fort Collins (USA). Solar Energy Applications Lab.	
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EG-77-S-03-1359	Harvey Mudd Coll., Claremont, CA (USA)	
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EG-77-S-05-5362	Alabama Univ., Huntsville (USA). Kenneth E. Johnson Environmental and Energy Center	
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EG-77-S-05-5528	Texas Univ., Austin (USA). Dept. of Chemistry	
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EG-78-C-07-1701	Utah Univ., Salt Lake City (USA). Research Inst.	
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EM-75-F-01-8155	Ohio State Government, Columbus (USA)	
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EM-76-C-01-8656	JRB Associates, Inc., McLean, VA (USA)	
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EM-76-F-01-8163	Hawaii Univ., Manoa (USA). Hawaii Natural Energy Inst.	
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EM-78-C-01-5174	Florida Solar Energy Center, Cape Canaveral (USA)	
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EM-78-S-04-5336	New Mexico Univ., Albuquerque (USA). Bureau of Engineering Research	
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EN-77-C-01-5068	Combustion Engineering, Inc., Windsor, CT (USA)	
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	5:20564	Dep. NTIS, PC A99/MF A01
	5:20849	Dep. NTIS, PC A99/MF A01
	5:20897	Dep. NTIS, PC A99/MF A01
	5:20916	Dep. NTIS, PC A99/MF A01
	5:21021	Dep. NTIS, PC A99/MF A01
	5:21022	Dep. NTIS, PC A99/MF A01
	5:21044	Dep. NTIS, PC A99/MF A01
	5:21045	Dep. NTIS, PC A99/MF A01
	5:21046	Dep. NTIS, PC A99/MF A01
CONF-790815-	(Cryogenic engineering conference, Madison, WI, USA, 21-24 Aug 1979)	
36	5:20221	*See* KMSF-U-907
CONF-790838-	(23. annual international symposium of the Society of Photographic Instrumentation Engineers, San Diego, CA, USA, 27-30 Aug 1979)	
4	5:21096	*See* PNL-SA-7738
5	5:21103	*See* PNL-SA-7737
6	5:20435	*See* PNL-SA-7692

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CONF-790847-		(International conference on high energy physics and nuclear structure, Vancouver, Canada, 13-17 Aug 1979)
17	5:21434	*See* LBL-9595
CONF-790857-		(4. international conference on ellipsometry, Berkeley, CA, USA, 20-23 Aug 1979)
2	5:21102	*See* LBL-9428
CONF-790917-		(American Chemical Society national meeting, Washington, DC, USA, 10-14 Sep 1979)
21	5:20999	*See* LBL-10348
CONF-790950-		(International seminar on ion-atom collisions (ISIAC VI), Tokai-mura, Japan, 6-7 Sep 1979)
3	5:21387	*See* COO-10514-2
CONF-7909102-		(Argonne specialists' workshop on basic research needs for nuclear waste management, Argonne, IL, USA, 5-6 Sep 1979)
2	5:20175	*See* PNL-SA-7953
CONF-7909111-		(Symposium on the history of the ZGS, Argonne, IL, USA, 13-14 Sep 1979)
3	5:21063	*See* ANL-HEP-CP-80-09
CONF-7909132-		(International symposium - methods of nondestructive testing of materials and their application in nuclear engineering, Saarbrucken, F.R. Germany, 17-19 Sep 1979)
1	5:20599	*See* PNL-SA-7746
CONF-7909133-		(Alternative gas workshop, Los Alamos, NM, USA, 5-6 Sep 1979)
	5:20072	*See* LA-8155-C
CONF-791008-		(ASNT fall conference, St Louis, MO, USA, 15-19 Oct 1979)
5	5:20655	Dep. NTIS, PC A02/MF A01
CONF-791009-		(International conference on energy use management, Los Angeles, CA, USA, 22-26 Oct 1979)
38	5:20802	Dep. NTIS, PC A02/MF A01
CONF-791014-		(4. annual conference on materials for coal conversion and utilization, Gaithersburg, MD, USA, 9-11 Oct 1979)
1	5:19971	*See* ISM-246
CONF-791021-		(2. American Electroplaters Society symposium on coatings for solar collectors, St Louis, MO, USA, 16-17 Oct 1979)
3	5:20430	Dep. NTIS, PC A02/MF A01
CONF-791022-		(4. national passive solar energy conference, Kansas City, KS, USA, 3-5 Oct 1979)
15	5:20364	Dep. NTIS, PC A02/MF A01
CONF-791031-		(6. conference on probability and statistics in atmospheric sciences, Banff, Alberta, Canada, 9-12 Oct 1979)
2	5:21133	Dep. NTIS, PC A02/MF A01
CONF-791033-		(1. annual ONWI information meeting, Columbus, OH, USA, 30 Oct-1 Nov 1979)
4	5:20126	*See* RHO-SA-141
5	5:20125	*See* RHO-SA-136
6	5:20123	*See* HEDL-SA-1891-FP
7	5:20161	*See* HEDL-SA-1892-FP
8	5:20122	*See* HEDL-SA-1890-FP
CONF-791049-		(23. conference on analytical chemistry in energy technology, Gatlinburg, TN, USA, 9-11 Oct 1979)
25	5:20946	Dep. NTIS, PC A02/MF A01
CONF-791050-		(3. Nuclear Energy Agency seminar on marine radioecology, Tokyo, Japan, 1-5 Oct 1979)
2	5:20176	*See* PNL-SA-8011
CONF-791051-		(3. ASTM-EURATOM symposium on reactor dosimetry, Ispra, Italy, 1-5 Oct 1979)
20	5:21090	Dep. NTIS, PC A02/MF A01
21	5:20642	Dep. NTIS, PC A02/MF A01
CONF-791058-		(International conference on nuclear cross sections for technology, Knoxville, TN, USA, 22-26 Oct 1979)
67	5:21054	Dep. NTIS, PC A02/MF A01
70	5:21414	Dep. NTIS, PC A03/MF A01
CONF-791063-		(Conference on thermodynamics of aqueous systems with industrial applications, Washington, DC, USA, 22-24 Oct 1979)
2	5:19953	Chicago, IL; Institute of Gas Technology (1979).
3	5:20961	*See* ISM-252
CONF-791077-		(Workshop on measurement and interpretation of actinide accumulation by man, Snowbird, UT, USA, 14-18 Oct 1979)
5	5:21323	Dep. NTIS, PC A02/MF A01
CONF-791092-		(Symposium of northeastern accelerator personnel, Philadelphia, PA, USA, 8-10 Oct 1979)
3	5:21064	Dep. NTIS, PC A02/MF A01
CONF-7910103-		(Workshop on the production of new particles in super high energy collisions, Madison, WI, USA, 22-24 Oct 1979)
5	5:21396	*See* LBL-10428
CONF-7910108-		(Symposium on separation science and technology for energy applications, Gatlinburg, TN, USA, 30 Oct-2 Nov 1979)
3(Draft)	5:19989	Dep. NTIS, PC A03/MF A01
CONF-7910119-		(8. annual conference of the I.N.T.D.S., Boston, MA, USA, 1-3 Oct 1979)
4	5:21065	Dep. NTIS, PC A02/MF A01
CONF-7910123-		(Lunar and Planetary Institute topical conference on the ancient sun, Boulder, CO, USA, Oct 1979)
4	5:21372	*See* LA-UR-80-928
CONF-7910130-		(Boulder damage conference, Boulder, CO, USA, Oct 1979)
2	5:20926	*See* UCRL-84247
CONF-7910137-		(WMO symposium on long-range transport of pollutants, Sophia, Bulgaria, 10 Oct 1979)
1	5:21165	*See* PNL-SA-7541
2	5:21166	*See* PNL-SA-7546
CONF-7910138-		(3. conference of chlorination: environmental impact and health effects, Colorado Springs, CO, USA, 28 Oct-2 Nov 1979)
1	5:21209	*See* PNL-SA-7883
2	5:21204	Dep. NTIS, PC A02/MF A01
CONF-7910139-		(ACM mid-southeast chapter fall meeting, Gatlinburg, TN, USA, 12 Oct 1979)
1	5:20778	*See* K/CSD/INF-79/19
CONF-7910143-		(3. all-union symposium on impulsive pressures, Moscow, USSR, 16-18 Oct 1979)
(Summ.)	5:20886	*See* SAND-80-6004
CONF-791102-		(8. symposium on engineering problems of fusion research, San Francisco, CA, USA, 13-16 Nov 1979)
137	5:21522	*See* UCRL-82984
146	5:21515	Dep. NTIS, PC A02/MF A01
151	5:21518	*See* GA-A-15642
CONF-791103-		(American Nuclear Society meeting, San Francisco, CA, USA, 12-16 Nov 1979)
76	5:20648	Dep. NTIS, PC A02/MF A01
77	5:20643	Dep. NTIS, PC A02/MF A01
78	5:21013	Dep. NTIS, PC A02/MF A01
79	5:20114	Dep. NTIS, PC A02/MF A01
80	5:20638	Dep. NTIS, PC A02/MF A01
82	5:20274	Dep. NTIS, PC A02/MF A01
84	5:21014	Dep. NTIS, PC A02/MF A01
87	5:21015	Dep. NTIS, PC A02/MF A01
89	5:21540	Dep. NTIS, PC A02/MF A01
90	5:21016	Dep. NTIS, PC A02/MF A01
91	5:21012	Dep. NTIS, PC A02/MF A01
92	5:20656	Dep. NTIS, PC A02/MF A01
93	5:21516	Dep. NTIS, PC A02/MF A01
95	5:20649	Dep. NTIS, PC A02/MF A01
95(Rev.)(Draft)	5:20603	Dep. NTIS, PC A02/MF A01
96	5:21442	Dep. NTIS, PC A02/MF A01
97	5:20639	Dep. NTIS, PC A02/MF A01
98	5:20154	Dep. NTIS, PC A02/MF A01
99	5:20613	Dep. NTIS, PC A02/MF A01
101	5:20198	Dep. NTIS, PC A02/MF A01
102	5:21473	Dep. NTIS, PC A02/MF A01
104	5:20606	Dep. NTIS, PC A02/MF A01
CONF-791108-		(72. AICHE meeting, San Francisco, CA, USA, 25-29 Nov 1979)
22(Draft)	5:19986	Dep. NTIS, PC A03/MF A01
23	5:20237	Dep. NTIS, PC A02/MF A01
CONF-791112-		(Symposium on the scientific basis for nuclear waste management, Boston, MA, USA, 26 Nov 1979,-29 Nov 1979/REPLACES CONF-791173)
50	5:20130	Dep. NTIS, PC A02/MF A01
54	5:20863	Dep. NTIS, PC A02/MF A01
55	5:20275	Dep. NTIS, PC A02/MF A01
56	5:20864	Dep. NTIS, PC A02/MF A01
57	5:20140	Dep. NTIS, PC A02/MF A01
58	5:20155	Dep. NTIS, PC A02/MF A01
59	5:20865	Dep. NTIS, PC A02/MF A01
CONF-791117-		(ANS topical conference, Kiawah Island, SC, USA, 26 Nov 1979,-19 Nov 1979/ REPLACES CONF-791180)

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22	5:20203	Dep. NTIS, PC A02/MF A01
23	5:20206	*See* DPSPU-79-30-16
CONF-791118-	(7. water reactor safety research information meeting, Gaithersburg, MD, USA, 5-9 Nov 1979)	
8	5:20596	Dep. NTIS, PC A02/MF A01
CONF-791143-	(Users Association solar fuels workshop, Albuquerque, NM, USA, 28-29 Nov 1979)	
6	5:20242	*See* SERI/TP-333-507
CONF-791151-	(Inhomogeneous superconductors conference, Berkeley Springs, WV, USA, 1-3 Nov 1979)	
	5:21454	New York, NY; American Institute of Physics (1980).
CONF-791181-	(34. annual meeting of the Southeast Division of the Association of American Geographers, Nashville, TN, USA, 18-20 Nov 1979)	
1	5:20722	Dep. NTIS, PC A02/MF A01
CONF-791182-	(4. international ozone conference, Houston, TX, USA, 26-29 Nov 1979)	
1	5:20150	*See* RHO-SA-98
CONF-791204-	(2. Miami international conference on alternative energy sources, Miami Beach, FL, USA, 10-13 Dec 1979)	
35	5:20229	Dep. NTIS, PC A02/MF A01
CONF-791205-	(ASME winter annual meeting, New York, NY, USA, 2-7 Dec 1979)	
20	5:20338	*See* PNL-SA-7580
21	5:20349	*See* PNL-SA-7567
22	5:20352	Dep. NTIS, PC A02/MF A01
CONF-791223-	(NEANDC specialist meeting on neutron cross sections of fission product nuclei, Bologna, Italy, 12-14 Dec 1979)	
6	5:21443	Dep. NTIS, PC A02/MF A01
CONF-791228-	(EBT ring physics workshop, Oak Ridge, TN, USA, 3-5 Dec 1979)	
	5:21460	Dep. NTIS, PC A23/MF A01
	5:21461	Dep. NTIS, PC A23/MF A01
	5:21462	Dep. NTIS, PC A23/MF A01
	5:21463	Dep. NTIS, PC A23/MF A01
	5:21464	Dep. NTIS, PC A23/MF A01
	5:21465	Dep. NTIS, PC A23/MF A01
	5:21466	Dep. NTIS, PC A23/MF A01
	5:21470	Dep. NTIS, PC A23/MF A01
	5:21471	Dep. NTIS, PC A23/MF A01
	5:21472	Dep. NTIS, PC A23/MF A01
	5:21479	Dep. NTIS, PC A23/MF A01
	5:21486	Dep. NTIS, PC A23/MF A01
	5:21487	Dep. NTIS, PC A23/MF A01
	5:21488	Dep. NTIS, PC A23/MF A01
	5:21489	Dep. NTIS, PC A23/MF A01
	5:21490	Dep. NTIS, PC A23/MF A01
	5:21491	Dep. NTIS, PC A23/MF A01
	5:21492	Dep. NTIS, PC A23/MF A01
	5:21496	Dep. NTIS, PC A23/MF A01
	5:21497	Dep. NTIS, PC A23/MF A01
	5:21498	Dep. NTIS, PC A23/MF A01
	5:21501	Dep. NTIS, PC A23/MF A01
	5:21502	Dep. NTIS, PC A23/MF A01
	5:21503	Dep. NTIS, PC A23/MF A01
	5:21504	Dep. NTIS, PC A23/MF A01
	5:21505	Dep. NTIS, PC A23/MF A01
	5:21506	Dep. NTIS, PC A23/MF A01
	5:21507	Dep. NTIS, PC A23/MF A01
CONF-791238-	(13. European conference on laser interaction with matter, Leipzig, German Democratic Republic, 10-14 Dec 1979)	
1	5:21531	*See* KMSF-U-951
CONF-791240-	(International conference on nonlinear dynamics, New York, NY, USA, 17-21 Dec 1979)	
1	5:21089	*See* BNL-27390
CONF-800101-	(Systems simulation and economics analysis conference, San Diego, CA, USA, 23-25 Jan 1980)	
	5:20256	*See* SERI/TP-351-431
	5:20257	*See* SERI/TP-351-431
	5:20262	*See* SERI/TP-351-431
	5:20263	*See* SERI/TP-351-431
	5:20268	*See* SERI/TP-351-431
	5:20269	*See* SERI/TP-351-431
	5:20310	*See* SERI/TP-351-431
	5:20324	*See* SERI/TP-351-431
	5:20335	*See* SERI/TP-351-431
	5:20336	*See* SERI/TP-351-431
	5:20337	*See* SERI/TP-351-431
	5:20340	*See* SERI/TP-351-431
	5:20341	*See* SERI/TP-351-431
	5:20345	*See* SERI/TP-351-431
	5:20350	*See* SERI/TP-351-431
	5:20353	*See* SERI/TP-351-431
	5:20385	*See* SERI/TP-351-431
	5:20386	*See* SERI/TP-351-431
	5:20387	*See* SERI/TP-351-431
	5:20388	*See* SERI/TP-351-431
	5:20389	*See* SERI/TP-351-431
	5:20390	*See* SERI/TP-351-431
	5:20391	*See* SERI/TP-351-431
	5:20392	*See* SERI/TP-351-431
	5:20393	*See* SERI/TP-351-431
	5:20394	*See* SERI/TP-351-431
	5:20395	*See* SERI/TP-351-431
	5:20396	*See* SERI/TP-351-431
	5:20397	*See* SERI/TP-351-431
	5:20398	*See* SERI/TP-351-431
	5:20399	*See* SERI/TP-351-431
	5:20400	*See* SERI/TP-351-431
	5:20401	*See* SERI/TP-351-431
	5:20402	*See* SERI/TP-351-431
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	5:20419	*See* SERI/TP-351-431
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	5:20423	*See* SERI/TP-351-431
	5:20424	*See* SERI/TP-351-431
	5:20425	*See* SERI/TP-351-431
	5:20438	*See* SERI/TP-351-431
	5:20504	*See* SERI/TP-351-431
	5:20786	*See* SERI/TP-351-431
CONF-800102-	(International conference on geotechnical and environmental aspects of geopressure energy, Sea Island, GA, USA, 13-20 Jan 1980)	
3	5:20069	Institute of Gas Technology, Chicago, IL
CONF-800118-	(2. AES design and finishing of printed wiring and hybrid circuits symposium, San Francisco, CA, USA, 15-17 Jan 1980)	
3	5:21041	*See* BDX-613-2323
CONF-800129-	(Energy from biomass and wastes 4 symposium, Lake Buena Vista, FL, USA, 21-25 Jan 1980)	
3	5:20243	Chicago, IL; Institute of Gas Technology (1980).
CONF-800135-	(Rubey colloquium, Los Angeles, CA, USA, 28 Jan 1980)	
1	5:20486	*See* LA-UR-80-731
CONF-800201-	(COMPCON 1980, San Francisco, CA, USA, 25-28 Feb 1980)	
7	5:21544	Dep. NTIS, PC A02/MF A01
CONF-800202-	(SAE automotive engineering congress and exposition, Detroit, MI, USA, 25-29 Feb 1980)	
3	5:20848	*See* LBL-10365
CONF-800205-	(American Institute of Metallurgical Engineers meeting, Las Vegas, NV, USA, Feb 1980)	
5	5:20882	*See* DP-MS-79-61
8	5:20940	Dep. NTIS, PC A02/MF A01
10	5:20869	Dep. NTIS, PC A03/MF A01
CONF-800208-	(Tropical meeting on inertial confinement fusion, San Diego, CA, USA, 26-28 Feb 1980)	
12	5:21536	*See* UCRL-84002
CONF-800226-	(Specialists meeting on decay heat removal and natural circulation in FBR's, Upton, NY, USA, 28-29 Feb 1980)	
4	5:20669	*See* HEDL-SA-1919-FP
CONF-800231-	(3. international conference on nondestructive evaluation in the nuclear industry, Salt Lake City, UT, USA, 11-13 Feb 1980)	
2	5:20870	Dep. NTIS, PC A02/MF A01
CONF-800232-	(International conference on extreme states in nuclear systems, Dresden, German Democratic Republic, 4-8 Feb 1980)	
1	5:21432	*See* LA-UR-80-723

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CONF-800301-	(2. international symposium on gaseous dielectrics, Knoxville, TN, USA, 9-13 Mar 1980)	
4	5:21350	Dep. NTIS, PC A02/MF A01
5	5:21141	Dep. NTIS, PC A02/MF A01
6	5:21386	Dep. NTIS, PC A02/MF A01
CONF-800302-	(25. international gas turbine conference, New Orleans, LA, USA, 9-13 Mar 1980)	
5	5:20533	Dep. NTIS, PC A02/MF A01
CONF-800303-	(179. national meeting of the American Chemical Society, Houston, TX, USA, 23-28 Mar 1980)	
14	5:19978	Dep. NTIS, PC A02/MF A01
15	5:20118	*See* DP-MS-79-99
16	5:20991	*See* DOE/ER/05528-18
CONF-800307-	(Fiber optic in the nuclear environment symposium, Adelphi, MD, USA, 25 Mar 1980,-27 Mar 1980/REPLACES CONF-800322)	
6	5:20932	*See* SAND-80-0554C
CONF-800309-	(International workshop on the energy/climate interactions, Munster, F.R. Germany, 3-7 Mar 1980)	
4	5:19987	Dep. NTIS, PC A03/MF A01
CONF-800313-	(Waste management conference, Tucson, AZ, USA, 10 Mar 1980)	
5	5:20129	*See* UCRL-83976
6	5:20147	*See* LA-UR-80-696
CONF-800315-	(2. symposium of the European Safeguards Research and Development Association, Edinburgh, UK, 26 Mar 1980)	
10	5:20210	*See* LA-UR-80-755
11	5:20208	*See* LA-UR-80-740
12	5:20209	*See* LA-UR-80-741
13	5:20947	*See* LA-UR-80-743
14	5:20207	*See* LA-UR-80-689
16	5:20215	*See* UCRL-82225
17	5:20211	*See* LA-UR-80-774
18	5:20213	*See* SAND-80-0721C
CONF-800327-	(2. joint conference on applications of air pollution meteorology, New Orleans, LA, USA, 24-27 Mar 1980)	
2	5:21175	*See* DP-MS-79-75
4	5:21134	Dep. NTIS, PC A02/MF A01
5	5:21144	*See* DP-MS-79-72
9	5:21168	*See* UCRL-83287
CONF-800329-	(1. workshop on nuclear dynamics, Tahoe City, CA, USA, 17-21 Mar 1980)	
1	5:21428	Dep. NTIS, PC A02/MF A01
2	5:21421	Dep. NTIS, PC A02/MF A01
CONF-800334-	(2. DOE environmental control symposium, Reston, VA, USA, 17-19 Mar 1980)	
1	5:21550	*See* UCRL-84102
4	5:20090	*See* LA-UR-80-876
6	5:20127	*See* SAND-80-0037C
8	5:21176	*See* EGG-1183-1759
10	5:20729	*See* SAND-80-0021C
CONF-800342-	(76. annual meeting Cordilleran Section Geological Society of America, Corvallis, OR, USA, 19-21 Mar 1980)	
1	5:20179	*See* RHO-BWI-SA-29
2	5:20180	*See* RHO-BWI-SA-32
CONF-800343-	(Conference on state energy audit impact '80, Norcross, GA, USA, Mar 1980)	
1	5:20798	Dep. NTIS, PC A02/MF A01
CONF-800344-	(3. invitational well testing symposium, Oakland, CA, USA, 26-28 Mar 1980)	
1	5:20499	*See* LA-UR-80-912
CONF-800345-	(Costa Rican workshop on energy and development, San Jose, Costa Rica, 17-21 Mar 1980)	
1	5:20737	Dep. NTIS, PC A03/MF A01
CONF-800346-	(Southeastern Section of the Geological Society of America conference, Birmingham, AL, USA, 27-28 Mar 1980)	
1	5:20097	*See* DP-MS-79-88
CONF-800348-	(5. marine recreational fisheries symposium, Savannah, GA, USA, 26-28 Mar 1980)	
1	5:21335	Dep. NTIS, PC A03/MF A01
CONF-800349-	(Annual meeting of the North American Benthological Society, Savannah, GA, USA, Mar 1980)	
1	5:19995	Dep. NTIS, PC A02/MF A01
2	5:21203	Dep. NTIS, PC A03/MF A01
CONF-800357-	(5. international conference on fracture, Cannes, France, 29 Mar-3 Apr 1980)	
1	5:20885	*See* SAND-80-0748C
CONF-800359-	(NEA specialist meeting on decommissioning requirements in the design of nuclear facilities, Paris, France, 17-19 Mar 1980)	
1	5:20138	*See* RHO-SA-148
CONF-800401-	(2. international conference of liquid metal technology for energy systems, Richland, WA, USA, 20-24 Apr 1980)	
2	5:20617	*See* GEFR-SP-210
3	5:20618	*See* GEFR-SP-212
4	5:20619	*See* GEFR-SP-213
5	5:20898	Dep. NTIS, PC A02/MF A01
6	5:21513	Dep. NTIS, PC A02/MF A01
7	5:20616	*See* GEFR-SP-172
CONF-800402-	(International symposium on the properties and applications of metal hydrides, Colorado Springs, CO, USA, 7-11 Apr 1980)	
10	5:20428	*See* SAND-79-1656C
CONF-800403-	(ANS thermal reactor safety meeting, Knoxville, TN, USA, 8-11 Apr 1980)	
18	5:20675	*See* SAND-80-0803C
19	5:20601	*See* SAND-80-0826C
20	5:20672	*See* SAND-79-1999C
21	5:20676	*See* SAND-80-0833C
22	5:20679	*See* SAND-80-0947C
23	5:20678	*See* SAND-80-0939C
25	5:20677	*See* SAND-80-0937C
27	5:20657	Dep. NTIS, PC A02/MF A01
32	5:20597	Dep. NTIS, PC A02/MF A01
33	5:20598	Dep. NTIS, PC A02/MF A01
34	5:20645	Dep. NTIS, PC A02/MF A01
35	5:20658	Dep. NTIS, PC A02/MF A01
36	5:20673	*See* SAND-79-2142C
38	5:20665	*See* GA-A-15622
39	5:20666	*See* GA-A-15625
40	5:20667	*See* GA-A-15649
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1	5:21034	*See* KAPL-4124
CONF-800408-	(Conference of the western states section of the Combustion Institute, Irvine, CA, USA, 21-22 Apr 1980)	
2	5:20026	*See* DOE/NASA/2593-80/15
CONF-800409-	(International conference on plasma physics, Nagoya, Japan, 7-11 Apr 1980)	
4	5:21494	*See* PPPL-1643
CONF-800414-	(DECUS spring symposium, Chicago, IL, USA, 22-25 Apr 1980)	
2	5:21547	*See* KMSF-U-969
CONF-800416-	(UCC-ND and GAT waste management seminar program, Portsmouth, OH, USA, 22-23 Apr 1980)	
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CONF-800419-	(5. symposium on automotive propulsion systems, Dearborn, MI, USA, 14-18 Apr 1980)	
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2	5:20186	*See* SAND-79-2245C
3	5:20185	*See* SAND-79-2244C
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2	5:20521	*See* SERI/TP-351-546
CONF-800425-	(13. oil shale symposium, Golden, CO, USA, 16-18 Apr 1980)	
2	5:20094	*See* UCRL-83738
3	5:20085	*See* UCRL-83740
4	5:20080	*See* UCRL-83742
5	5:20079	*See* UCRL-83739
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1	5:21441	*See* UCRL-83457
CONF-800427-	(Tritium technology in fission, fusion, and isotopic application, Dayton, OH, USA, 29 Apr-1 May 1980)	
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4	5:21017	Dep. NTIS, PC A02/MF A01
5	5:21018	Dep. NTIS, PC A02/MF A01
CONF-800432-		(2. international conference on multiphoton processes, Budapest, Hungary, 14-18 Apr 1980)
1	5:21389	*See* LA-UR-80-922
CONF-800433-		(4. international conference on nuclear methods in environment and energy research, Columbia, MO, USA, 14-17 Apr 1980)
1	5:20944	Dep. NTIS, PC A02/MF A01
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3	5:20659	Dep. NTIS, PC A02/MF A01
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1	5:21493	*See* LA-UR-80-738
CONF-800441-		(International symposium on physics and open-ended fusion systems, Tsukuba, Japan, 15-18 Apr 1980)
1	5:21510	*See* UCRL-84228
CONF-800442-		(Symposium on sputtering, Vienna, Austria, 28-30 Apr 1980)
1	5:21390	*See* SAND-79-2385C
CONF-800443-		(Consumer Product Safety Commission symposium concerning formaldehyde, Washington, DC, USA, 11 Apr 1980)
1	5:21142	Dep. NTIS, PC A02/MF A01
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1	5:20131	Dep. NTIS, PC A02/MF A01
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1	5:21526	*See* COO-2218-153
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1	5:20660	Dep. NTIS, PC A02/MF A01
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CONF-800507-		(Rock mechanics symposium, Rolla, MO, USA, 27-30 May 1980)
1	5:20012	*See* SAND-79-2355C
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4	5:20187	*See* SAND-79-2254C
5	5:20088	*See* SAND-79-2312C
CONF-800508-		(2. biophysical meeting on proteins and nucleoproteins: structure, dynamics, and assembly, Airlie, VA, USA, 19-20 May 1980)
1	5:21250	*See* SAND-80-0050C
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2	5:21560	*See* UCRL-84076
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1	5:21020	*See* SAND-78-1121C
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2	5:21392	*See* UCRL-83925
CONF-800517-		(26. annual technical meeting of the Institute for Environmental Sciences, Philadelphia, PA, USA, 11-14 May 1980)
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3	5:21537	*See* UCRL-84258
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1	5:20772	*See* LA-UR-80-816
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6	5:20441	*See* UCRL-83506
7	5:20377	*See* LA-UR-80-701
8	5:20378	*See* LA-UR-80-702
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30	5:20149	*See* RHO-SA-51
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1	5:21148	*See* LA-UR-80-754
2	5:20790	*See* LBL-10527
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1	5:21038	*See* UCRL-82842
2	5:21040	*See* UCRL-82868
4	5:21039	*See* UCRL-82867
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1	5:21028	*See* DOE/ER/10350-1
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5	5:20234	*See* UCRL-83540
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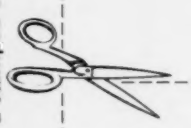

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